# SKYWAYS

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## Revolution in Air Force Research

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## Airline Pilots Look At Safet

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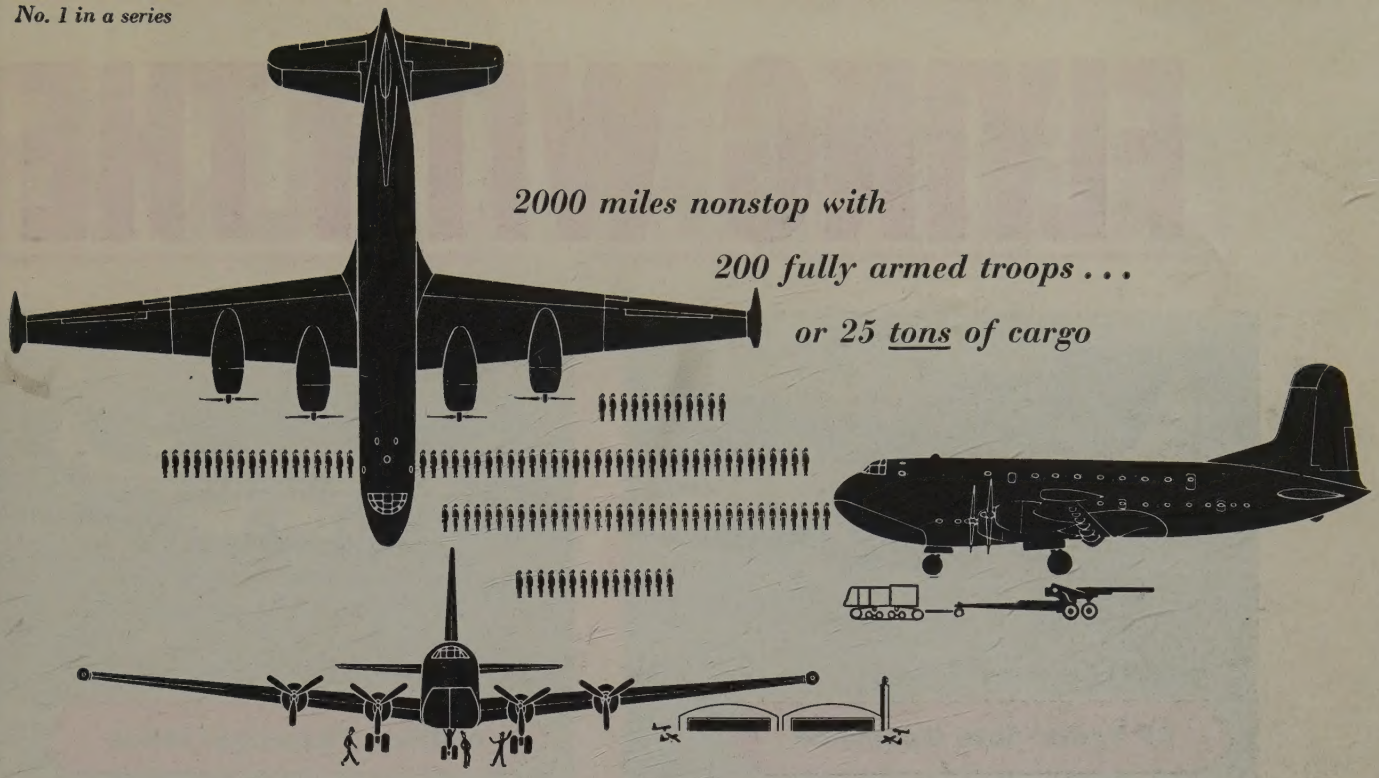

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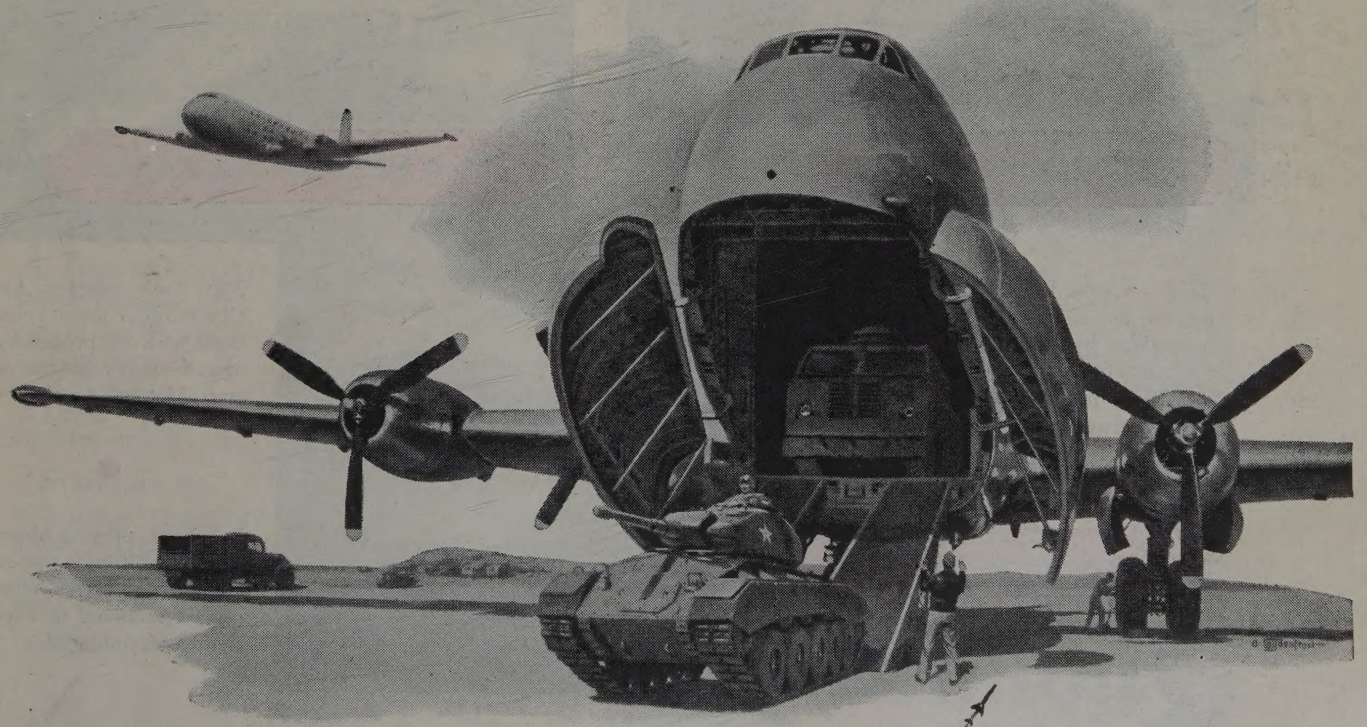

**Depend on *DOUGLAS*** **First in Aviation**

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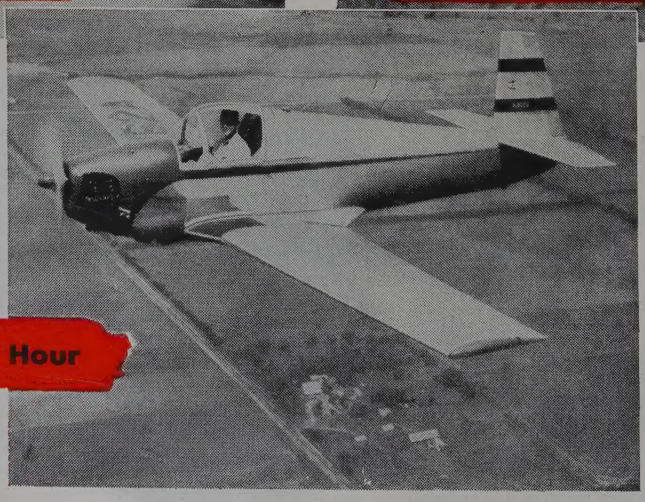


Bob Faris, piloting Mooney Mite in 1230-mile non-stop record for midget planes, proved economy of Flying Red Horse products!

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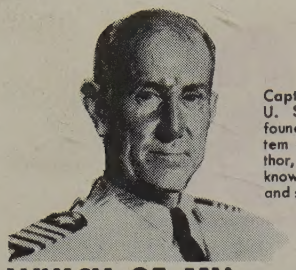

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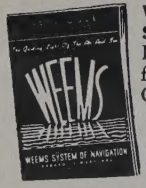


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# SKYWAYS

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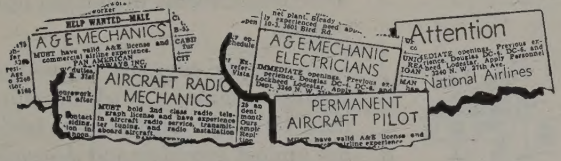


*We can* offer you *definite proof* of the above statement... or, to prove it to yourself, watch the "Help Wanted" columns of any of the big city newspapers. Aside from the fact that there *are* many many jobs open in aviation today, the future requirements of this tremendous, rapidly-growing industry will assuredly grow far in excess of the number of men available and qualified to fill the jobs.

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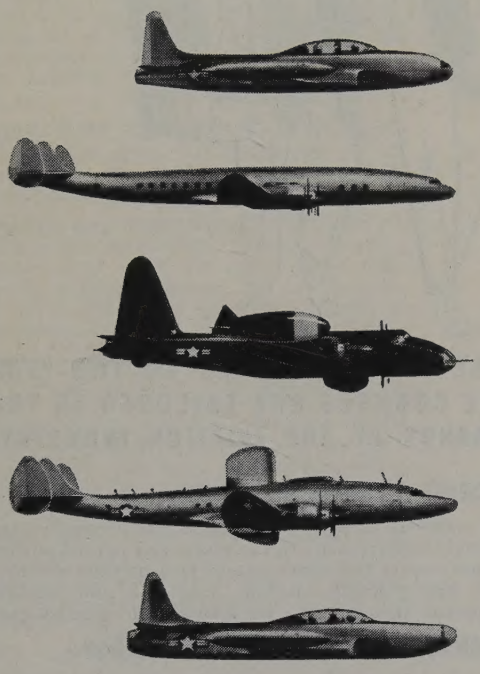
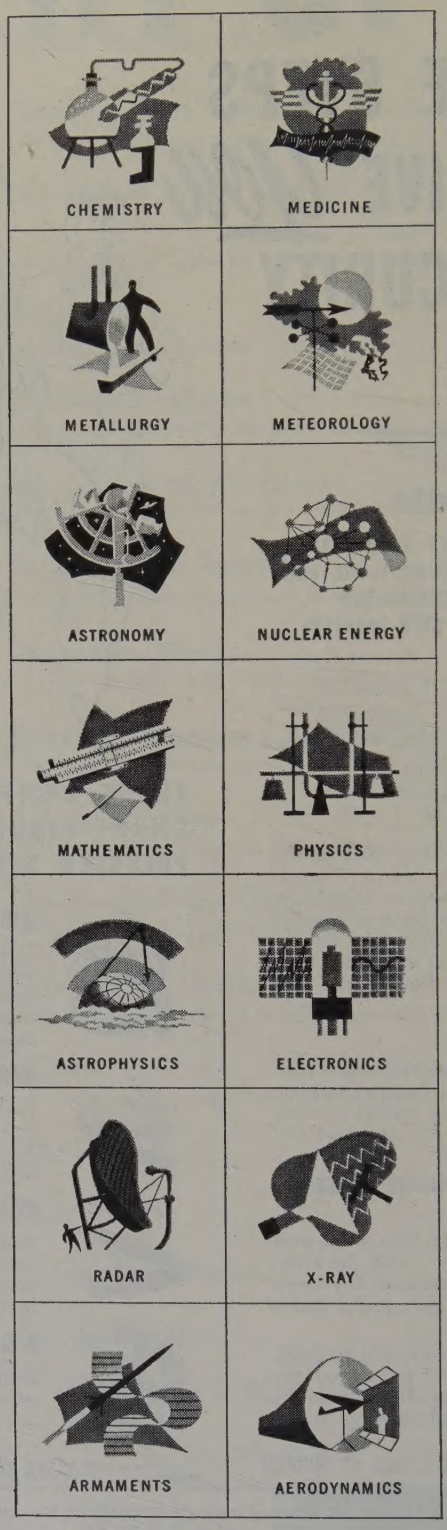


T-33 JET TRAINER
SUPER CONSTELLATION
P2V NEPTUNE
MILITARY CONSTELLATION
F-94 STARFIRE

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New buildings, providing laboratories in nearly every known science, have been added to Lockheed's Research Center in Burbank, Calif. Each building was designed for a special purpose. Each contributes to research, testing, invention or design —to help solve any new aircraft need or problem.

Lockheed's new 5-story Engineering Building, for example, houses a streamlined science headquarters, where engineers delve into such subjects as atomic research, pilotless aircraft, jet transports and advanced supersonic fighters.

### SCIENCE CENTER

Lockheed advanced blueprints go to work in the new Research Center, which includes an aerodynamics laboratory, testing laboratory, wind tunnel, electronics laboratory, weather laboratory, chemistry laboratory and hydraulics laboratory. Here, meteorologists check the effects of every kind of weather on every vital plane part—shooting Sahara sand into engine bearings, growing tropical fungus on wiring, building Arctic ice on leading edges. These, and hundreds of other scientific tests, result in greater dependability in Lockheed planes.

Another advanced building at Lockheed is the massive Hall of Giants, which contains the nation's largest industrial equipment for building aircraft.

The new designs and methods which are developed almost daily at Lockheed are necessarily classified today. When they can be talked about, they will go down in history along with the many other Lockheed engineering firsts.

# AIR YOUR VIEWS

### C-47 or DC-3

Gentlemen:

Could you tell me the exact difference between a C-47 and a DC-3? A friend and I have been arguing about whether or not they are one and the same plane.

J. L. SAMUELS

Dodge City, Kansas

Gentlemen:

Would you setttle a question? A friend of mine maintains there is a twin-engine DC-4 transport, and I say the DC-4 is a four-engine plane with the modified version being the DC-6. I say the DC-3 is the twin-engine job, also known as the C-47 and C-53.

E. F. PIERCE

North Chicago, Illinois

*The Douglas DC-3 is a twin-engine commercial transport, the military version of which is designated C-47. The C-53 is the troop-carrier version of the cargo-carrier C-47. The DC-4 has and always d'd have four engines. Military designat on of the commerical DC-4 is C-54. The DC-6 is a larger and more powerful development of, and successor to, the DC-4. Military designation of the DC-6 is C-118. We hope that answers the questions of both Mr. Samuels and Mr. Pierce.*—ED.

### F3F-3 and F5F

Gentlemen:

Would you give me please the performance, powerplant and armament of the Grumman F3F-3 and F5F?

J. B. PEWITT

Louisville, Kentucky

*The F3F-3 was first flown in December, 1933. It was powered by a Wright R-1820-22 engine and had a cruising speed of 230 mph. It was armed with one 30-cal. and one 50-cal. machine gun. The F5F was actually the XF5F, Skyrocket. It never became a production airplane. It was a twin-engine single-place fighter monoplane, powered by two Wright 1820-42 engines, cruised at 290 mph and carried two .50-cal and two .30 cal. machine guns.*

### Outside Loop

Gentlemen:

I would like to know if it is possible for a plane to do an inverted or outside loop?

H. DOWNS

Winton, N. C.

*Yes. In an outside loop, the loop starts from normal flight and passes successively through a dive, inverted flight, climb, and then back to normal flight, the pilot always being on the outside of the flight path. Several aerobatic pilots flying aircraft stressed for aerial aerobatics have done outside loops.*—ED.

### Private Pilots

Gentlemen:

Could you shed a little light on this question for me? I want to know how many non-commercial pilots there are in the United States.

H. W. LUNDGREN

Villa Park, Illinois

*According to the latest CAA Statistical Handbook, there were 328,380 licensed private pilots as of 1949 (Dec. 31). There were 92,809 civil aircraft (including gliders) as of that date; 9,025 licensed transport pilots, 187,769 pilots with commercial licenses, and (as of Dec. 31, 1950) 44,591 student pilot approvals.*—ED.

### Will She Stall

Gentlemen:

In reading the article, "Will She Stall," in the February issue, I was surprised at your answer to the question. Truth of the matter is, if your 40-mph headwind should stop it would only change the groundspeed, not the IAS, and groundspeed does not affect stalling. My answer to your question would be, "It would continue its approach in a normal manner."

R. E. KEOUGH

4th Inf. APO 39
New York, N Y.

### Civil Air Patrol

Gentlemen:

I am extremely interested in joining the Civil Air Patrol. Would you give me the address of the Pennsylvania Wing?

T. B. BECKELMAN

Shenandoah, Penn.

*For information concerning the Pennsylvania Wing of the CAP, write to Col. P. F. Neuweiler, 744 N. Front Street, Allentown.*—ED.

### $$$ to Cuba

Gentlemen:

I am taking the liberty of enclosing a copy of a letter addressed to the Cuban Secretary of State explaining in detail how they charge private pilots excessive landing fees and custom brokerage (these people do the work custom officials should do and charge exorbitant rates for filling out a few papers) when visiting Cuba. Perhaps exposing this banditry would put an end to it.

M. FIRNHABER

Waukesha, Wisconsin

*For our reader's interest, we herein offer a condensation of Mr. Firnhaber's letter: "The purpose of this letter (to Dr. Aureliani Sanchez Arango) is to bring to your attention some of the excessively high custom fees and brokerage charge private pilots. Here is a complete review of my visit to your country: 1) I was charged $13.60 for a telegram to your Minister of Defense (sent by Cuban Consul at Key West) for permission to fly to Rancho Boyeros in Havana. On arriving at Rancho Boyeros, we were charged $2.50 for landing fee, plus a brokerage charge of $12.50. 2) We spent the morning at the Ministerio de Commicaciones and finally secured permission to fly over the island to Kingston, Jamaica. Department was very cooperative and there were no charges. 3) We flew to Aeropuerto de Canaguey, Cuba. The following morning the local customs official presented us with a bill for $10.00. The customs man insisted on collecting the fee which he claimed was for overnight and to impress us he had with him a soldier with a submachine gun. 4) We flew on to Kingston, Jamaica, and found our treatment in this British colony completely different. The only fee we had to pay was our initial landing fee of $2.50, and their attitude was one of complete cooperation and courtesy. 5) Going back to the States we had to go through Cuba again, and had to pay an additional $5.00 brokerage fee, another $5.00 for health certificate, and $2.50 for taxicab for two customs men to come to the airport. If you wish private pilots to visit your country, you'd better eliminate these fees and teach your soldiers courtesy." Hm . . . Mr. Firnhaber, your complaint is a duplicate of many received from visitors to Cuba. Efforts are being made by various organizations to eliminate this condition, but nothing concrete has been accomplished yet. We hope the picture will soon be different.*—ED.

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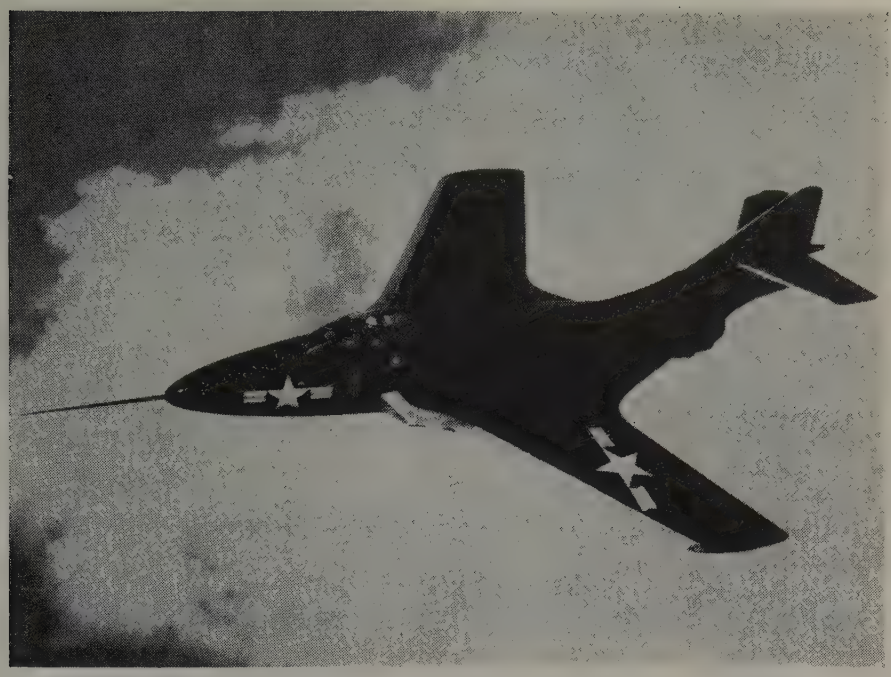


**NAVY FIGHTER,** latest of the line of Grumman aircraft, is the new F9F-6 *Cougar*, a sweptwing successor to the *Panther*. For security reasons, speed is listed as "over 600 mph"

# MILITARY AVIATION

### *Navy's Cougar*

Newest "cat" out of the Grumman "bag" of fighters is the F9F-6 *Cougar*, a sweptwing successor to the *Panther*. Powered by a Pratt & Whitney turbojet engine (designation classified at this time), the *Cougar* is said to be much faster than its predecessor, although retaining the same low landing and take-off speed.

### *. . . and the Fury*

Another new Navy carried-based fighter is the North American FJ-2 *Fury*, a sweptwing version of the FJ-1. Classified as a 650-mph aircraft, the FJ-2 is powered by a GE J-47 turbojet engine, has a range of 1,000 miles and a service ceiling in excess of 45,000 feet. It carries four 20-mm cannon.

### *High-Altitude Altimeters*

Two new altimeters which are expected to measure altitudes ranging from 25 to 95 miles in the upper atmosphere are under development, according to announcement by the Air Force's Air Research and Development Command. One type altimeter is designed for operation between 150,000 and 300,000 feet; the other, between 300,000 and 500,000 feet. The altimeter designed for the 150,000 to 300,000 level is basically a Pirani-type gage; the second is an ionization-type gage. Experimental models of both have been built by Eclipse-Pioneer Division, Bendix Aviation.

### *Sabre Edge*

According to recent report, the Air Force F-86 *Sabre* jets hold a 129 to 14 kill ratio over the Red Mig 15 in Korea. Although the two airplanes are similar (both have roughly the same sweepback of wing and tail, both have engine air intake in the nose, and the engine thrust is the same) and their maximum level flight and diving speeds are potentially the same, there are two basic differences: the Mig is considerably lighter than the *Sabre* and so has a superior rate of climb, particularly above 30,000 feet; and the Mig employs a very elementary flight-control system which, in the opinion of U. S. engineers and designers, is inadequate for today's operating speeds. In short, the *Sabre* and Mig are about alike in level flight and dive speed; the *Sabre* has a better range while the Mig has a better climb; but the *Sabre* offers better flight control.

### *News Notes*

LOCKHEED reports first plane to be built in its new Special Projects Center at Burbank, Calif., will be the Air Force XC-130, a turboprop military cargo ship.

CONVAIR announced an Air Force contract for prototype production of a new high-performance interceptor aircraft. Neither the Air Force nor Convair will give further details, but widespread opinion is that it is for a delta wing plane to be designated XF-102.

NAVY has cancelled its plans for procurement of the F3D-3 twin-jet all-weather carrier-based fighter, a sweptwing version of the F3D-2 *Skyknight*. This cancellation does not affect present procurement of the F3D-2.

CANADAIR LTD., of Montreal expects to begin delivery of 500 *Sabres* for the Royal Air Force early next year. *Sabre* airframes are to be built by Canadair, while engines will come from the U.S.

ALLISON J-71 (formerly designated J-35-A-23) may power a new version of the Northrop F-89 *Scorpion* night fighter. The J-71 is in the "over 9,000 pounds thrust class."

GENERAL ELECTRIC has developed a new all-electric automatic pilot designated G-3 by the Navy. It is in operational use on the Douglas F3D-2 *Skyknight* and is expected to go into the Grumman F9F-5P *Panther* and the Douglas A2D.

**NAVY FJ-2** is sweptwing version of the FJ-1 *Fury*. Built by North American, the new *Fury* is a carrier-based jet fighter powered by a GE J-47. It is in the "650-mph class"

# Close Support In Korea

**AIR FORCE** Pfc K. G. Walsh relays information to pilots of T-6's overhead who, in turn, call in fighters to hit ground targets

**AIR FORCE** jet, Lockheed F-80 *Shooting Star (in circle)*, banks sharply to line up another Communist target in its gunsights

## By M/Sgt. Richard Bartlett

*Hq. FEAF, Tokyo*

Imagine, if you can, a Communist-held ridge north of the 38th Parallel somewhere in Korea. The fanatic Reds have just thrown back a heartbreaking assault by United Nations troops—the first UN assault against this small but important mountain top, and the Chinese know another and more determined attack will soon follow.

Two Commie heavy machine-gun emplacements are located in the rocky outcroppings of two right-angle ridge fingers, sweeping the only ground approaches to their dug-in positions. Seasoned invaders, the Reds are also aware that a close-support air strike could hit them at any time. Hatefully, they eye the slow flying, unarmed T-6 Mosquito plane circling noisily around and around

**THUNDERJETS,** flying close support in Korea, knock out rail lines in Red-held North Korea

their bastion. And whenever they feel it is low enough, they shoot at it with their machine guns and carbines. But, like a dreaded omen, the small plane continues to circle. Suddenly the Commies' attention is distracted by artillery fire. Burning white phosphorus shells begin exploding, sending ghostlike fingers through the air; mortar shells search for machine-gun positions. Occasionally the side of a bunker is blown in, smothering the cries of wounded men. Finding targets, bits of searing metal burn through make-shift uniforms. Then, almost as suddenly as it began, the fire lifts. The Reds tense themselves for another infantry assault.

But without warning the sudden crunching slap of bullets hitting the bodies of their comrades heralds the arrival of the dreaded UN air power.

Like silver exclamation points to the death that precedes them, F-80 jets smash through the second of silence that always marks their arrival. For the next 20 minutes that narrow ridge becomes a hell on earth.

Fifty-caliber armor-piercing and incendiary bullets sweep the sides and top of the rock-studded ridge, leaving tell-tale scars that many of the Reds can't escape. Then comes the napalm, blistering, searing and scorching everything its sticky fingers touch. Bouring into some foxholes and sweeping like a fiery blanket across others, the napalm does its job well.

The smoking tail of a rocket follows down to disappear in a blast that splits open boulders and spews away earth from the machine-gun emplacements. One is destroyed. Four, five and six times the jets twist down, streaking into the attack, then scream upward, balancing on the pencil of smoke from their tails. And it's all over.

The Mosquito pilot and his ground force observer in the rear cockpit have done their job well. By pinpointing individual positions, they have given the jets a sure mark. The jets, too, have done a good job. Later, after the hill is taken by the UN infantry, a ground report lists more than 50 per cent enemy casualties by air power.

Although this is a typical picture of a close-support air strike, it by no means tells the whole story—that can only be told when there is no longer a need for close support in Korea.

Fighting men whose "arm-chair" observations are confined to the questionable comforts of muddy Korean (*Continued on page 36*)

**ROCKETS** did the job for Lt. Iverson *(left)* and his observer Capt. Smith. On a tactical mission behind enemy lines, Iverson and Smith in their T-6 Mosquito knocked out a Red field piece

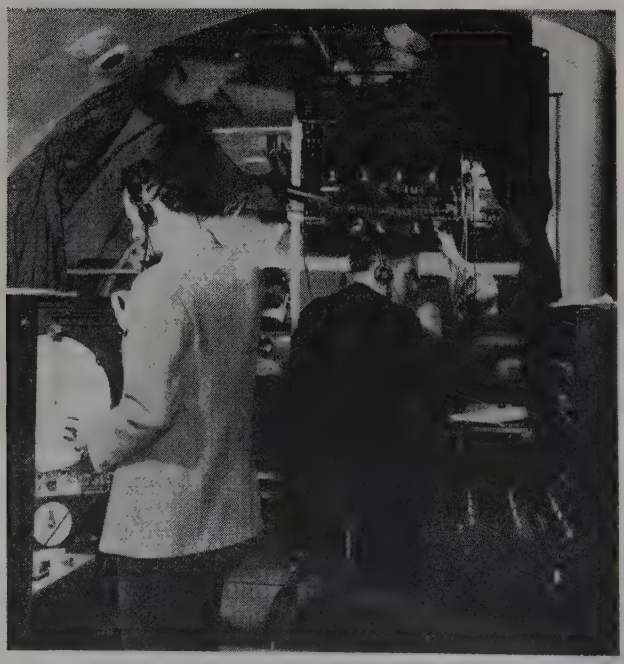
**OPERATION CHART** of Lockheed *Constellation* shows it to have good safety record; is designated L-649 in analysis

# The Airline Pilots Look at

Safety of airline transportation is important in a great many ways, the most important of which is the moral responsibility to the traveling public. In this paper*, however, a narrower and more personal viewpoint will be examined, that of the active airline pilots who daily fly the airlanes.

Safety to a pilot is extremely important in a personal sense. As the "man out front" he is vitally concerned with his own survival as well as with his primary assigned responsibility for the safety of his passengers and crew. He is also vitally affected by the impact of safety on his own airline particularly and the industry in general. His employment security, his opportunities for promotion, his pay, his choice of domicile, and his working conditions in general are all affected by the impact of the level of safety on the public's demand for air transportation. The effect of accidents is hard to judge but the following is typical.

On a flight the day after a well-publicized non-scheduled crash recently, the author had the opportunity to talk extensively with the small number of passengers aboard. During the conversations, it developed that a significant percentage were nervous about the flight, and several mentioned that they had almost cancelled their reservations in favor of going by boat. How many of the empty seats were due to this cause is hard to determine, but (*Continued on page 14*)



**DEHMEL TRAINER** is used by Pan American to determine whether present procedures are straining flight crews

**Text of the talk given by Capt. William Moss at the 20th Annual Forum of Institute of Aeronautical Sciences is reprinted here through courtesy of Institute of The Aeronautical Sciences*

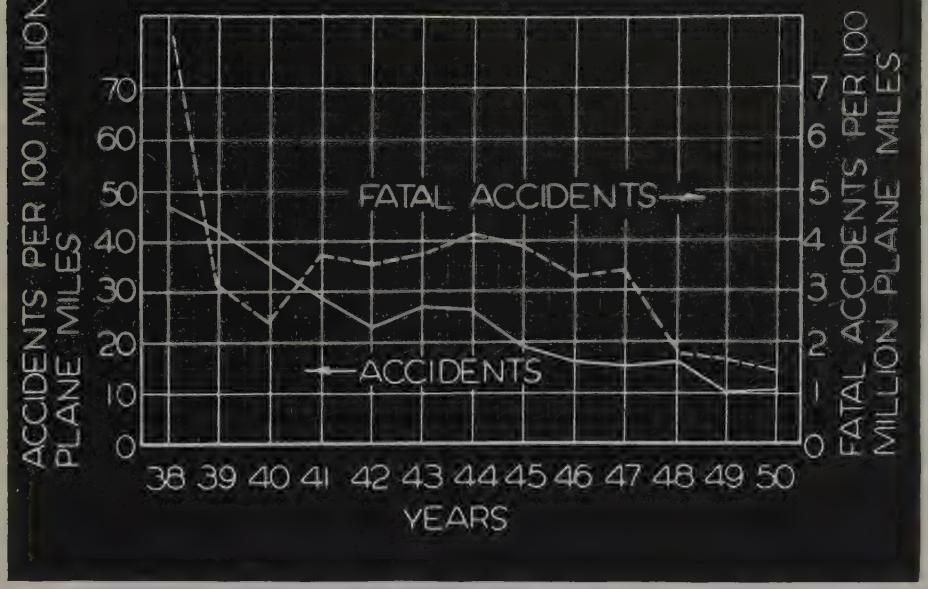
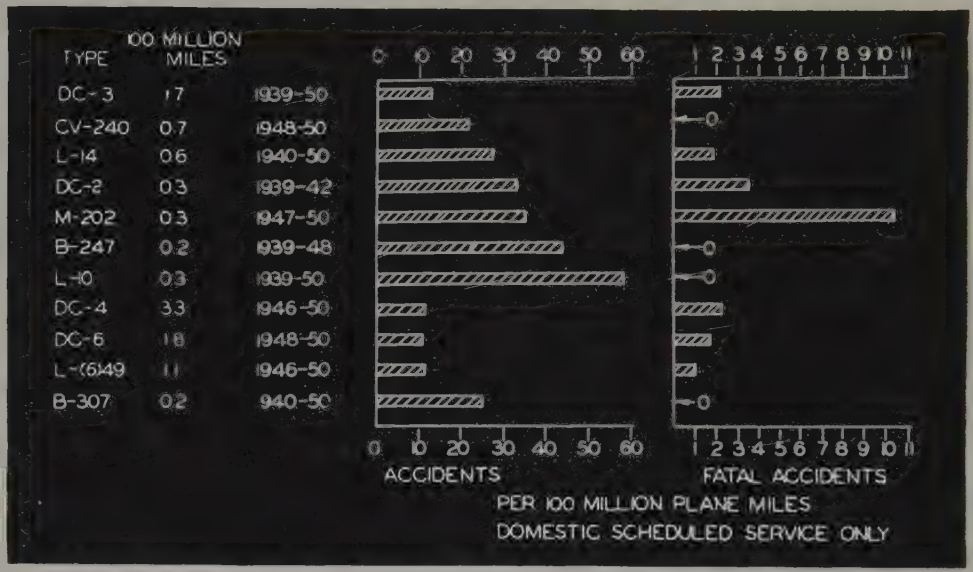

ACCIDENTS PER 100 MILLION PLANE MILES
FATAL ACCIDENTS PER 100 MILLION PLANE MILES
FATAL ACCIDENTS
ACCIDENTS
YEARS
38 39 40 41 42 43 44 45 46 47 48 49 50

**CHART** (Fig. 1), compiled by the Civil Aeronautics Board, shows accidents and fatal accidents per 100 million airplane miles; all flying done by U.S. scheduled domestic and international carriers, for the years between 1938 and 1950

# Safety

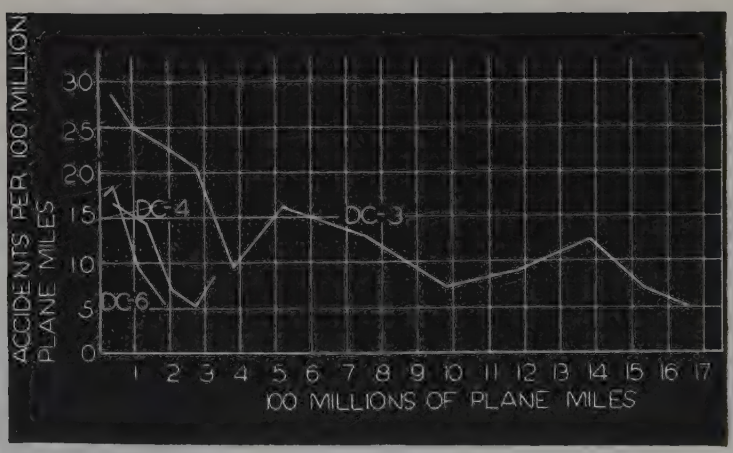



**CAB**, in this chart (Fig. 2), shows a comparison of the accident rates of widely used U.S. transport aircraft. Note that chart is per 100 million airplane miles in domestic scheduled air service only

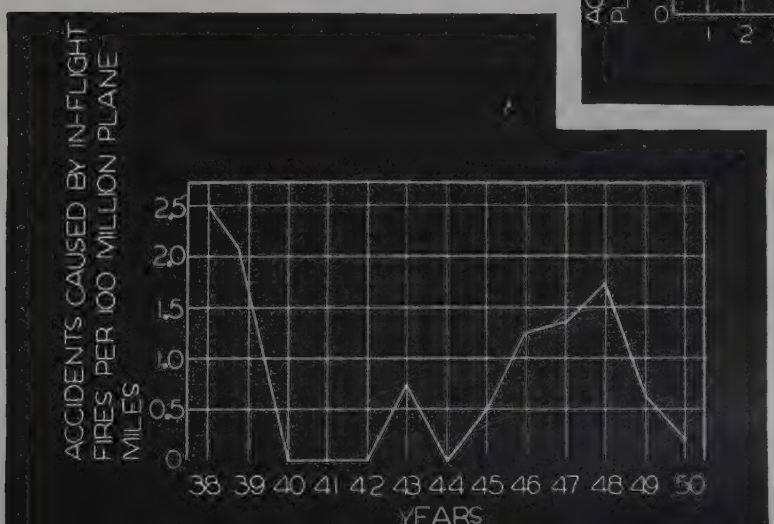
***Safety is result of integration of good design and operation***


## By Capt. William W. Moss

*Air Line Pilots Association*


**ACCIDENT CHART** (Fig. 3) shows accident rate as a function of cumulative miles flown by DC-3, DC-4, and DC-6 in domestic scheduled air service only




**CAB CHART** (Fig. 4) shows accidents caused by in-flight fires per 100 million plane miles (all operations: U.S. scheduled domestic, international)

Jerome Lederer said (*in a talk at the S.A.E. National Aeronautic Meeting in 1951*)

> "The traffic department of another large airline, after studying its variation of traffic with accidents, concludes that the effects of a well-publicized accident or series of accidents are felt for about two months. It results in an average loss of 10 per cent in passenger revenue during this period. This loss, at present levels of traffic, would amount to $1,700,000 for this one airline."

This form of measurement, however, touches only the effect on those who already travel by air. It takes little or no account of the potential air travelers who, because of fear, have never set foot in an airplane. It is a reasonable guess that the horizons of air transportation could be broadened considerably by a marked improvement in the safety record.

In assessing safety, it is necessary to know where we are and where we have been. Figure 1, "Accidents and Fatal Accidents per 100 Million Plane Miles" shows this. The author has chosen the parameters of plane miles and accidents rather than the usual ones of passenger fatalities per passenger mile because it is more representative of the pilot's viewpoint. He flies many thousands of miles per year, and from his personal safety angle it matters little if there are one or one hundred passengers riding behind him. He is particularly interested, however, in what is likely to happen during the millions of miles he will fly during his career.

Figure 1 is a plot of accidents and fatal accidents per 100 million plane miles for all flying by U. S. scheduled domestic and international airlines for the years 1938-50. All figures are taken from Civil Aeronautic Board records, and the Board's definition of an accident ("involving serious injury to persons and/or substantial damage to the aircraft") was used with no screening. The mileage for all types of flying, revenue, non-revenue, charter, ferry, test, and training was used, for it is obvious that the pilots were exposed to all types.

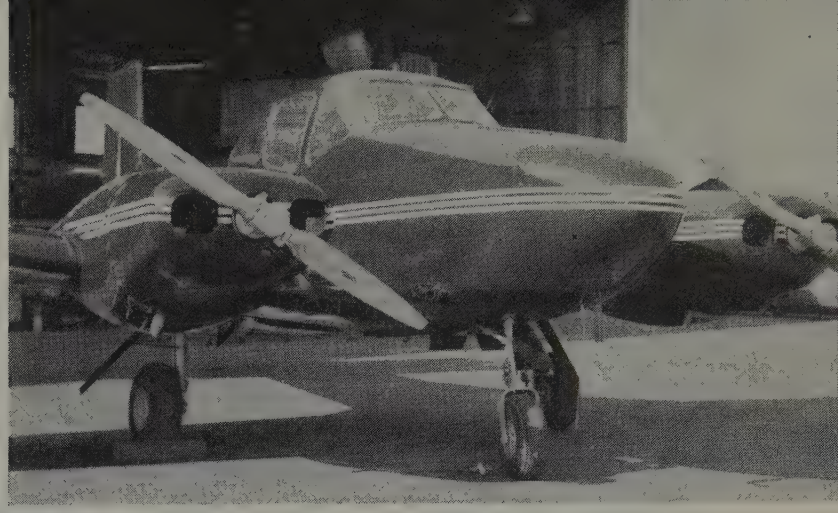
The most obvious conclusion to be drawn is that the record of both types of accidents has improved tremendously over the years, with accidents dropping from a rate of 48 to 10, and fatal accidents from approximately 8 to 1.5. This is indeed improvement.

In following the trend of the curves, several points are of significance. First is the rapid improvement in the years 1938-42. The pilots attribute this primarily to the influence of the Independent Air Safety Board. There were, of course, other factors involved, notably the wide introduction of the DC-3, but it is the pilot's opinion that a large share of this improvement was due to the many reforms and aggressive actions of the Air Safety Board during its brief life. While it is not the purpose of this paper to indulge in the controversy which has raged for years around this board, it appears desirable to comment in passing that the pilots still believe in the principle of independence involved, even though we feel that the present CAB Safety Bureau is doing a good job. We feel that if a board composed of experts has the power of enforcement, rather than having its recommendations and policy tempered by a higher authority of non-technical membership, greater safety progress would result with marked benefit to the industry.

The second period of interest in Figure 1 is the war years, 1943-45, in (*Continued on page 40*)

**INSTRUMENTS,** controls, gadgets have increased over the years: 289 for DC-3, 400 for DC-4 to 600 for DC-6 *(below)*

# TWIN *Navion*



**TWIN-NAVION,** as converted by Acme Aircraft, is powered by two Lycoming 0-290-D engines instead of one Continental engine. Props are Sensenich controllable Skyblades. Plane's radio, electrical equipment is now in the nose

If one engine does a good job, two engines ought to do better. At least that was the reasoning of the Plastics and Rubber Products Company, of Los Angeles, California. Using the company *Navion,* officials made frequent trips into the rough and rugged country around Cody, Wyoming. The possibility of having to land in the tree tops in case of engine failure set the officers of the company to looking around for a good twin-engine airplane.

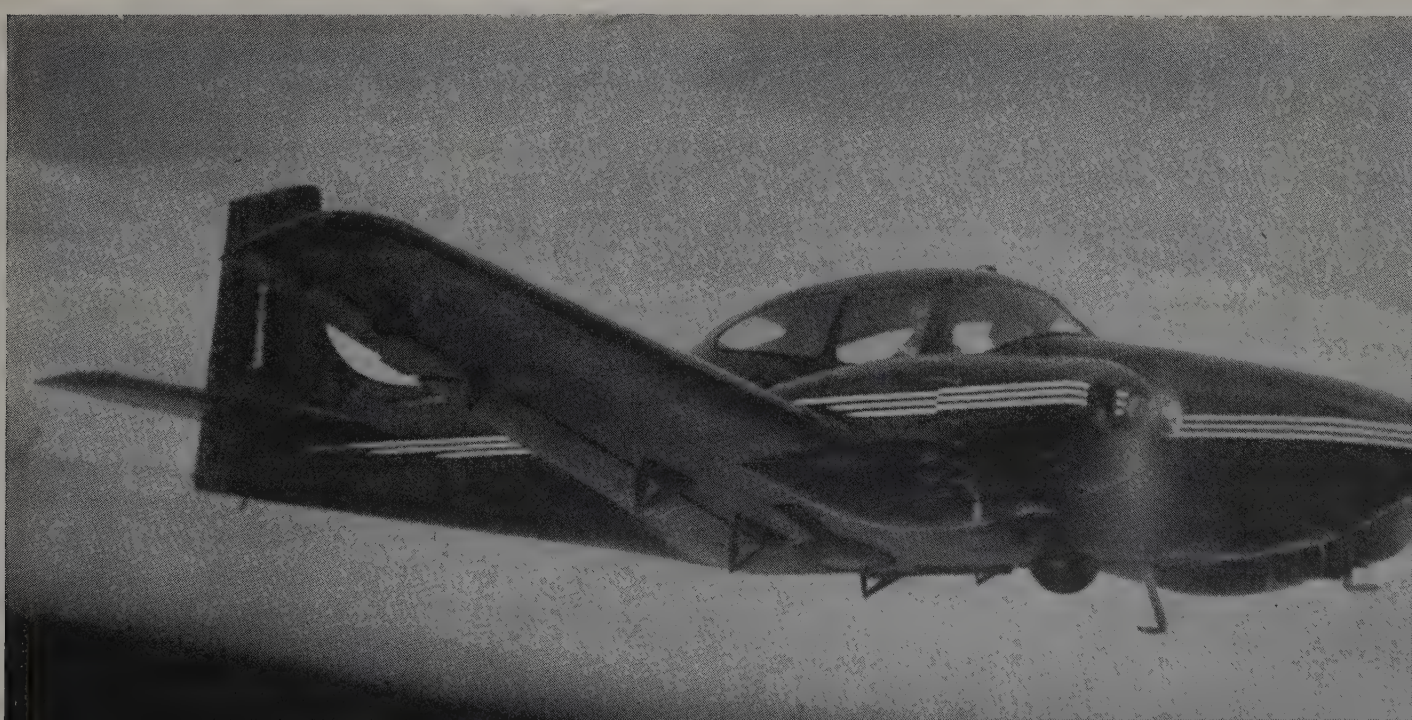
C. R. Keeney, head of Acme Aircraft Co., suggested they convert the single-engine *Navion* to a twin-engine. It was done . . . and successfully, too.

The original engine was removed, a tubing truss and skin-stressed nacelles were added to each wing, and then two Lycoming O-290-D engines installed. Center section of the wing was beefed up internally to handle load distribution, and all radio and electrical accessories were placed in the nose where the original engine had been. Forty per cent more fin area was added to counterbalance added area of two engine nacelles.

Flight tests indicate the twin-*Navion* will top 160 mph, will cruise at 135 mph, and will maintain altitude of 4,000 feet on one engine with full load. Gross weight remains the same.

**FLIGHT TESTS** of "new" *Navion* indicate it will cruise at 135 mph, climb to 2500 feet on one engine in 5 minutes





**CARGO** bound for Japan is backed up to C-54's on a runway at Hickam AFB in Hawaii. The average monthly tonnage airlifted to the Orient is now about 1800 tons of cargo and mail, and 5500 passengers

**FLIGHT SERVICE** personnel keep tabs on planes from take-off to landing. Deliberate deviations from flight plans are reported to insure safety in the air. FS is one of five support services of MATS

# Lesson in *Logistics*

## By Dick LaCoste

> *"Our Air Force has four main tasks. These main tasks are, first, the air defense of the United States, second, the strategic counter-attack, third, tactical air support, and fourth, air transport."*
>
> *Thomas Finletter, Sec., USAF*

When North Korean Communists pushed past the 38th Parallel on June 25, 1950, they set in motion a 7,000-mile strategic aerial supply operation—the longest in the history of world aviation.

By airlifting critical cargoes and high-priority personnel to the Far East in required tonnage and numbers, military and commercial carriers have dramatically underscored the fact that air transport has, indeed, attained its majority.

Before the Pacific Airlift began on July 1, 1950, fewer than 60 Military Air Transport Service aircraft were airlifting some 70 tons a month to Japan. Within a month, 95 tons of critical cargoes were being delivered daily to Japan alone. By September 1, 1950, a maximum number of 250 military, commercial and United Nations aircraft were airlifting a daily average of 106 tons to the entire Pacific area.

Shortly after the airlift began, the commercial carriers were called upon to supplement MATS strategic airlift to the Far East. By the end of August, 66 commercial planes from 17 scheduled and non-scheduled airlines were operating in the airlift.

The fleet was reduced to 37 by November, 1950,

due to decreased requirements for airlifted materials at that time. But in December, 1950, when the Chinese charged into the conflict, contracted commercial planes under MATS again were raised to 66.

During the last half of March, 1951, six U. S. commercial airlines planes again were released from airlift operations, reducing to 60 the number of planes being used.

Greater utilization of the MATS fleet, plus an increase in the number of trips allocated to all planes, allowed the reduction.

Coincident with airlines support, two Troop Carrier groups and United Nations aircraft—three Sabena planes, an RCAF squadron and three North Star transports from Canadian Pacific Airlines—began airlift operations.

Peak month of activity was September, 1950 when over 3,305 tons, including 13,000 passengers and 1,784 tons of cargo and mail, were delivered to the Far East.

From the start of the Pacific Airlift to December 1, 1951, MATS aircraft ferried some 121,000 passengers and more than 29,000 tons of cargo and mail in more than 8300 flights to the Far East.

The average monthly tonnage being airlifted to the Orient is now about 5500 passengers and 1800 tons of cargo and mail. To handle this tremendous flow of critical cargo and high priority personnel to the Far East, MATS has carved out three air lanes in support of its aerial bridge from California to Japan.

The shortest route is the Great Circle course, from McChord AFB, Tacoma, Wash., to Anchorage, Alaska, then across the Aleutian Island chain to Tokyo, using Shemya in the Aleutians as a refueling stop. Total distance: 5,688 miles. Flying time: 33 hours.

From Travis AFB, commercial planes head over a mid-Pacific air lane to Honolulu, thence on to Tokyo via Wake Island. Distance: 6,772 miles. Flying time: 38 hours. Military planes bridging this same route island-hop from Hawaii to Johnston Island, Kwajelein, Guam and Tokyo. Distance: 8,083 miles. Flying time: 45 hours.

One of the most dramatic by-products of these time-devouring and dangerous flights over the vast Pacific is the extra airlift they engender. (*Continued on page 47*)

**HELICOPTERS** evacuate wounded from Korean battlefields, fly them to field hospitals. Many are then airlifted back to U.S.

**CARGO OVER, WOUNDED BACK,** that is airlift plan of MATS. Since start of Korean action, 38,000 have been flown home

**CIVIL AIR PATROL** Stearman PT-13, flown by D. Nebeker Jr., lands on a highway near Provo, Utah during maneuvers

**AERIAL VIEW** of swollen Neosha River and the collapsed bridge near Wyandotte, Okla., was made by CAP airman

# Neighborhood Air Force

## By Miriam Lundy

At the height of last summer's disastrous floods in the Middle West scores of men, women and children crowded onto the Neosha River bridge at Wyandotte, Okla., fascinated by the raging torrents of debris-strewn water. They were unaware that the hammering of flood waters had opened big cracks in the structure's concrete supports. A pilot patrolling the river in a small plane saw the danger and tried to warn them by wagging his wings. When this went unnoticed, he swept low over the bridge, literally driving the indignant crowd to the shores. The last person had barely reached land when the bridge crashed.

The ingenious pilot was Alfred Bates, an electrician, of Muskogee, Okla. He is one of the 34,476 men and women in the United States and its territories who are giving their time, money and in

**ARIZONA CADETS** of the Civil Air Patrol paint large yellow crosses on wrecked planes to indicate they are old, not new

**WRECKED PLANE** was spotted by CAP Capt. Ellsworth who then directed ground party to the scene. CAP search started after plane was overdue at destination

some instances their lives to serve their fellow man. These 34,476 are senior members of the Civil Air Patrol, whose total strength tops 77,000, with the inclusion of 42,945 boy and girl cadets.

In case of disaster or emergency any locality in the country is within reach of the CAP. The senior members can put more than 5100 privately owned two-to-five-place planes into the air. When emergencies arise, the CAP rents additional planes. This air strength is backed up by ground-team work by hundreds of member-owned jeeps, horses, swamp buggies, motor boats and snowmobiles.

Tying all these elements together is the CAP's radio network of 9500 stations, the largest non-military radio system in the world. Most of these stations are mobile—either airborne or vehicular. The radios provide communication between planes and ground forces in search and rescue missions, such as children or hunters lost in woods or desert, and downed or crashed airplanes.

The 34,000 senior members are millionaires and grocery clerks, movie stars and housewives, farmers, lawyers, mechanics and members from almost every other occupation. A number of CAP members are retired and able to devote all their time to CAP; many others give half their time. But when the occasion demands, no CAP worker hesitates to take time off from his job to help.

Neither race nor creed nor age influences CAP membership. Many Indians belong to the Oklahoma Wing. In Nome, Alaska, there is an Eskimo squadron that uses dog teams for search and rescue. In Hawaii there is a CAP flight at the Molokai leper colony, their important work being radio communications. In March of last year, when a storm crippled communications and power facilities in the islands and vast areas were flooded, the Hawaiian CAP Wing took over all communications and assigned to the Molokai flight the job of making hourly weather reports. Only through these reports was Hawaii able to prepare for further disaster.

The only pay CAP members get for turning out at any time of the day or night, in good weather or bad, is the gratitude of those they help. They don't even get recom- (*Continued on page 44*)

**BLIZZARDS** in Minnesota area cut off transportation and communications. Civil Air Patrol took over emergency operations and flew mercy missions day and night. Here, at Wheaton, Minn., ailing woman was flown to ambulance

# Revolution in Research

***Weird designs in aircraft, atom-powered planes, missiles . . . all are hatching at Wright Field, experimental center for AF***

## By Douglas J. Ingells

About seven miles east of Dayton, Ohio where the Wright Brothers built the first successful heavier-than-air flying machine, a revolution in aeronautical research is in progress. Wright Field, the Air Force's multi-hundred-million dollar experimental test center, has mushroomed like an atom-bomb cloud since the outbreak of the Korean war. Its expansion, facility-wise, personnel-wise and activity-wise, already has surpassed the peak of World War II. And it is still growing.

Things are happening here today which indicate more than words and appropriations the trend in thinking of our Air Force leaders and military strategists everywhere; atom-powered planes, long-range guided missiles, weird new designs of aircraft, revitalization of the propeller, a brighter future for the helicopter—all are in the hatching.

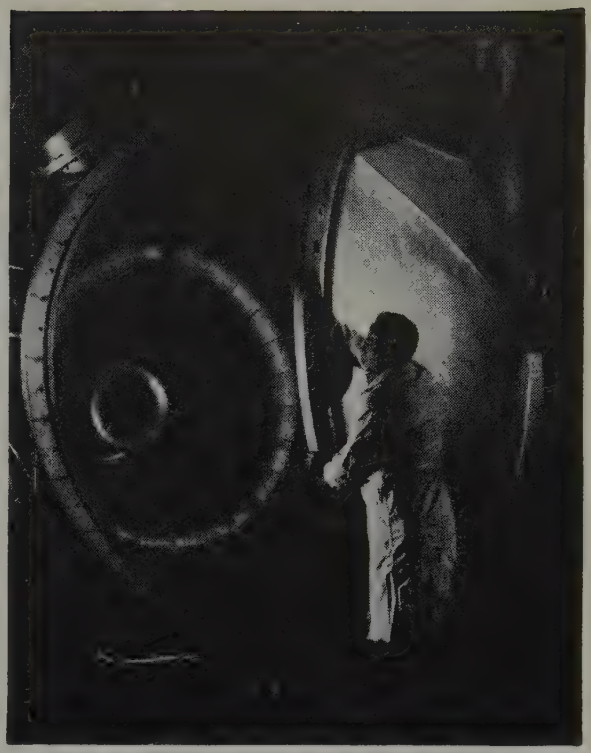
"Revolution in research," one engineer called it.

There is evidence of this everywhere on this sprawling 7200-acre military installation which embodies two great airfields (one having the longest concrete runway in the world) and a third administrative area which is headquarters for the vast and complex Air Material Command that buys, supplies and maintains the fighting air forces in Korea and

**WDAC MEN** consider Martin XB-61 pilotless bomber one of the top 10 technical advancements made during 1951

**SPIN TABLE** simulates "tumbling" which occurs during bailouts. Airman is strapped in, whirled to determine effects

**HELICOPTER** rotor stands test rotors up to 90 feet in diameter. All-steel frame towers are enclosed in a cage



**POWERPLANT** test chamber at Wright Field is used for high-altitude research on operation of gas-turbine engines

keeps planes, men and their bases alert and ready in the four far corners of the earth.

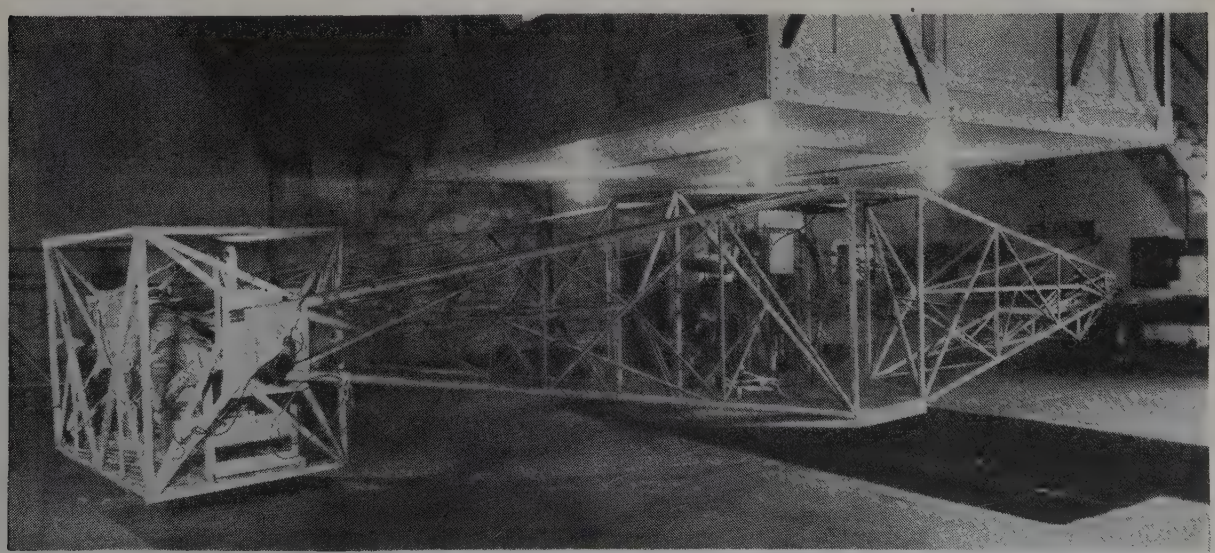
Cold figures themselves explain the expansion. Last year, for instance, AMC spent more than $13,000,000,000 buying everything from a match-box-sized radio set for forced-down flyers to the B-36 which costs upwards of $4,000,000 per plane. According to Lt. Gen. Edwin W. Rawlings, commanding general of the AMC whose field installations pock-mark the entire U. S., his organization will spend more than $16,000,000,000 this year. And the prospect is that the pocketbook will be bulging again in 1953.

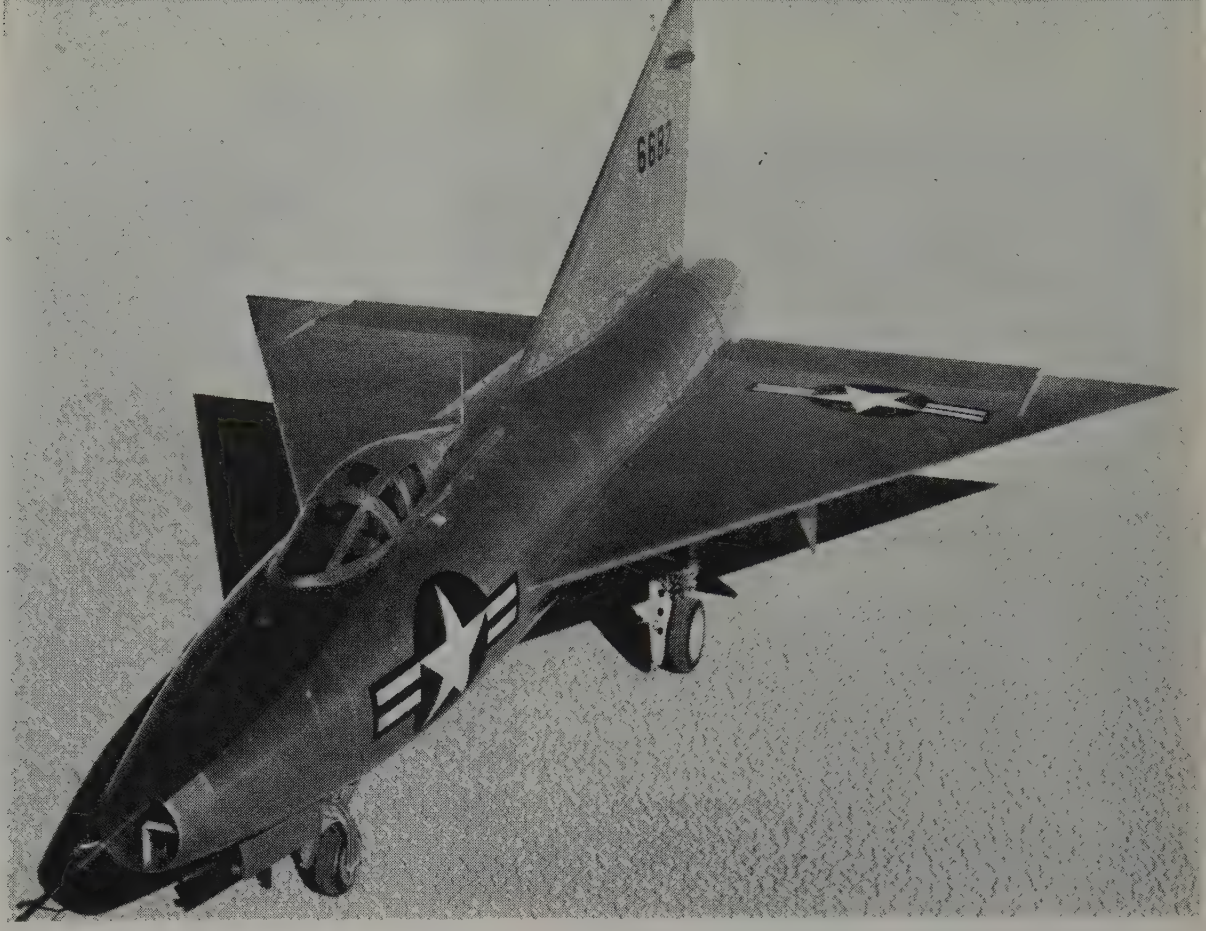
The fact sheet will also disclose that in another part of the civilian-military installation—old Wright Field which is now officially the Wright Air Development Center (WADC)—some of the hottest and most secret projects are making engineers and scientists burn the midnight oil.

In gathering material for this exclusive SKYWAYS article, I was told by one of the generals at WADC that "right now, Feb. 1, 1952, we have more than 1300 active individual projects."

These experiments range from the development of a new technique to stop a pilot from dangerous tumbling effects during a high-speed, high-altitude bailout in the pilot ejection seat, to highly secret drawing board studies of (*Continued on page 52*)

**CENTRIFUGE** is used for physiological tests of the G tolerances to which pilots of supersonic bombers, fighters are subjected. In this new type centrifuge it is possible to accelerate from zero to 10 G's in just one second





**DELTA WING XF-92A** is forerunner of delta-wing interceptor recently ordered by the Air Force from Consolidated Vultee. According to news report, the new delta-wing interceptor will be designated XF-102, be faster than XF-92

# The Delta Wing

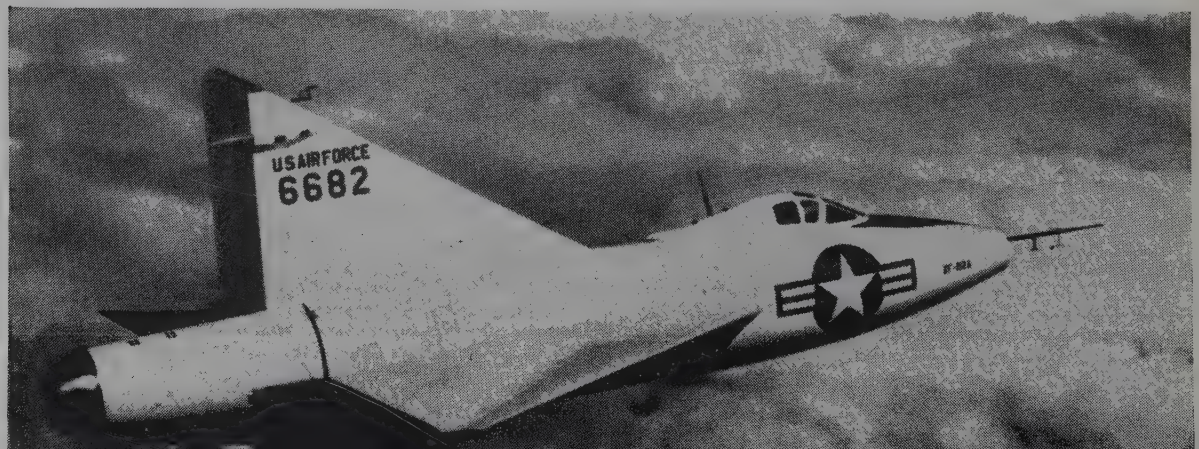
Is the Delta Wing tomorrow's airplane? Many claim it is. And judging from an Air Force announcement of an order for a delta-wing interceptor to be built by Convair, that claim is correct.

The Delta wing—aviation's flying triangle—has many advantages over the conventional sweptback aircraft flying today. Perhaps the singular results from this unconventional design may blue-print the piloted aircraft of the immediate future.

At this writing there is only one Delta-wing plane flying in the United States—Convair's XF-92A. Four models of more-or-less Delta configuration are flying in England, but the Avro 707 is the only true Delta design of the group.

From over two-and-a-half years of flight testing at the Edwards Air Force Base, certain unique advantages of the Delta-wing design have been proven. The Delta-wing shape is inherently strong because of its short span and relatively thick "beefy" wing

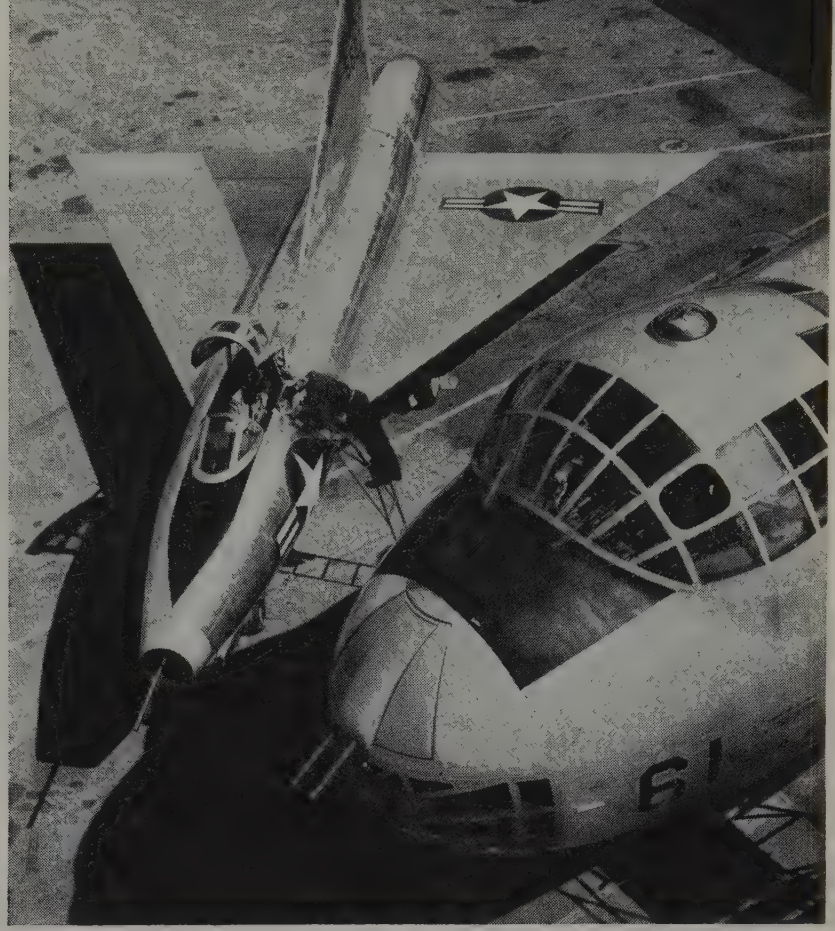
**CONVAIR XF-92A** is the only delta-wing aircraft flying in this country at this time. Note engine afterburner



***Aviation's flying triangle promises to be tomorrow's airplane, judging from a recent AF order***

## By Don Downie

**PROJECT ENGINEER** is Thomas M. Hemphill, a Convair man since 1931



**DELTA WING,** parked here alongside nose of the big B-36, is powered by J-33 turbojet engine. The XF-102 will have Pratt & Whitney J-57

section when compared with so-called conventional aircraft. This wing thickness, however, is actually a smaller percentage of the total chord of the wing than the conventional plane and results in a surprisingly smooth transonic passage.

The total wing area on the Delta configuration is roughly 70 per cent larger than a conventional design, resulting in equivalent landing speeds and more wing area to permit tight fighter turns in high, thin air.

The relatively large wing of the Delta design also makes room for internal fuel tanks, internally mounted armament and electronic equipment mounted within the wing rather than having to use such present-day protrusions as tip-tanks.

Add the production angle of an airplane that is roughly 20 per cent easier to build because it has no conventional tail, and you have what sounds like a bargain at anybody's aviation counter.

Many of the pilots on the Edwards Air Base flight staff have flown the XF-92A. The first flight was made in September, 1948, by Convair test pilot E. D. "Sam" Shannon. This follows the accepted Air Force testing procedure in which factory pilots run the Phase I original flight tests before turning the plane over to the military pilots.

Major Chuck Yeager had a flame-out 10 feet in the air on one take-off in the XF-92A before the original engine was replaced with the present J-33A-29 turbojet, rated at over 5200 pounds thrust with afterburner. Major Yeager made a safe landing on the broad dry-lake, and later praised the Delta wing to the skies.

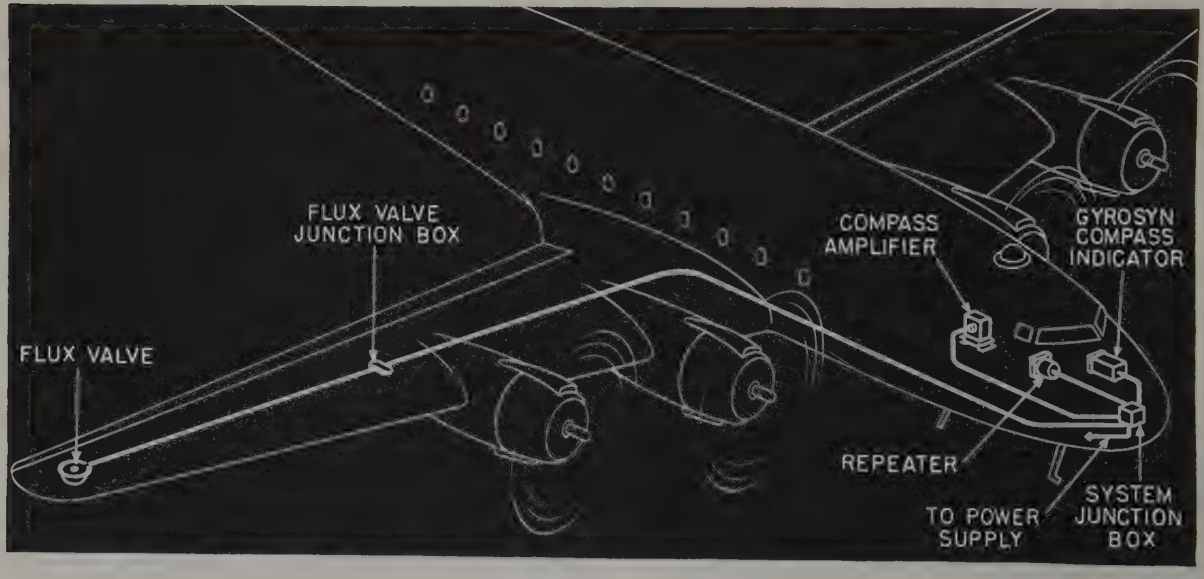
"The Delta-wing configuration is superior to straight or swept-wing configuration in high-speed flight, in maneuverability as a (gun) platform and in Mach drag. The Delta wing can out-turn at any altitude practically any airplane made," said Yeager, the first pilot to crack the speed of sound in the original X-1.

Basically, the Delta wing is an equilateral triangle, flying with the point forward. A minimum of fuselage is added on top of the wing to house the pilot and powerplant and a large fin and rudder assure good stability. While current sweptback fighters have an angle of 35°, the Delta wing is 60°. While sweptback fighters have a conventional tail group, the Delta wing has more of the flight characteristics of the flying wing than a conventional aircraft, yet has ample stability because of the large tail area. You can't stall the Delta wing. Original consideration of this unconventional design came out of the 1933-34 NACA research on low-aspect ratio wings, accord- (*Continued on page 55*)

# Remote-Indicating Compass System

**MULTI-ENGINE EXECUTIVE** aircraft, such as this Mobile Oil DC-3, are among the best instrumented planes flying today

**OUTLINE DRAWING** shows location on the plane of the component parts of the Gyrosen Compass system. Note Flux Valve




Basic navigational instrument for cross-country flight is the magnetic compass. Every plane that journeys farther than line-of-sight distance from its home field should, and probably does, have some type of compass aboard.

Small craft nearly always fly contact and, therefore, merely require a general indication of direction so as to prevent doing a "Wrong-Way Corrigan." For their use, the simple panel-mounted direct-view instrument is adequate.

The businessman pilot and executive-transport pilot, however, usually operate multi-engine craft and must often fly under instrument conditions, requiring a much more accurate and specific indication of direction. Many of these planes are equipped with improved versions of the direct-view magnetic compass, but they are actually handicapped by the inherent characteristics of this instrument.

The magnetic compass of today is basically the same device as was used by Columbus in his travels to the new world—with special adaptations for aerial flight, of course.

Essentially, the panel-mounted compass consists of two steel magnetized needles mounted on a float

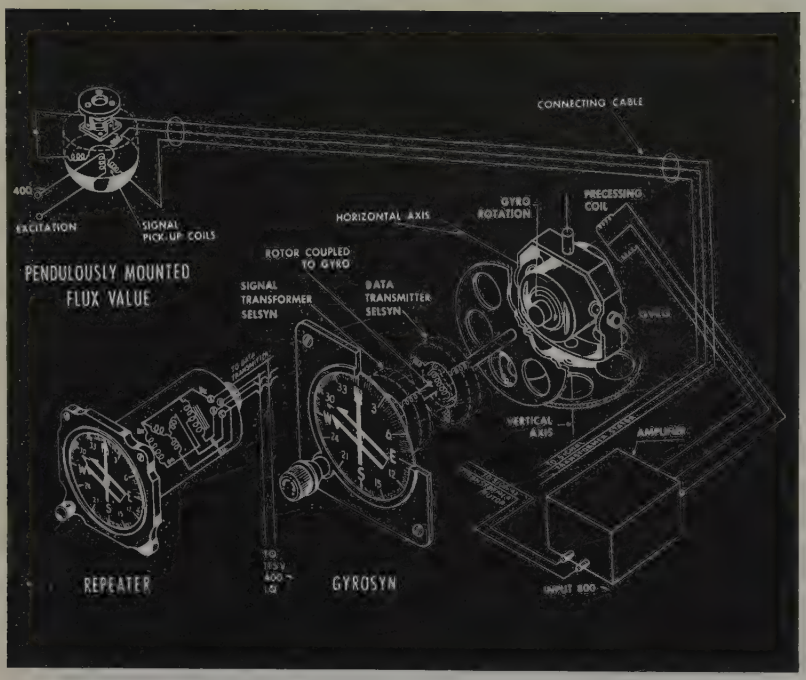


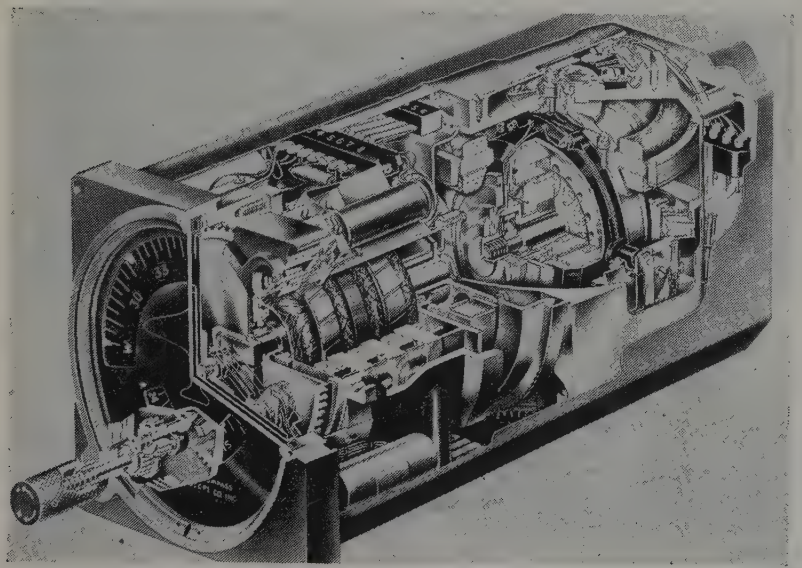

**DIAGRAM** shows simplified schematic of the Gyrosen gyro-magnetic compass

around which is mounted a compass card. The needles are parallel, with their north-seeking ends pointed in the same direction. Letters on the compass card indicate cardinal headings and every 30° is represented by a number, the last zero of which is omitted. Between these numbers, the card is graduated for each 5°. The float, with attached magnetized needles and compass card, is housed in a bowl filled with a liquid such as acid-free white kerosene. Purposes of this liquid are to dampen out excessive oscillations of the compass card and to relieve by buoyancy part of the weight of the float from the bearing.

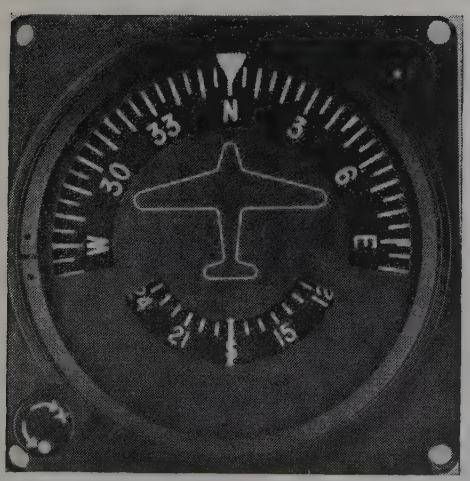
At the rear of the compass bowl a diaphragm is installed to allow for any expansion or contraction of the liquid due to changes in temperature or in barometric altitude, thus preventing the formation of bubbles or possible bursting of the case. The compass card and a fixed reference (lubber line) are visible through the glass face of the compass bowl. On top of the bowl is mounted a compensating device consisting usually of several small bar magnets which are adjustable by two set screws.

Panel- (*Continued on page 48*)

**BREAKAWAY** of the Indicator shows assembly of panel-mounted gage

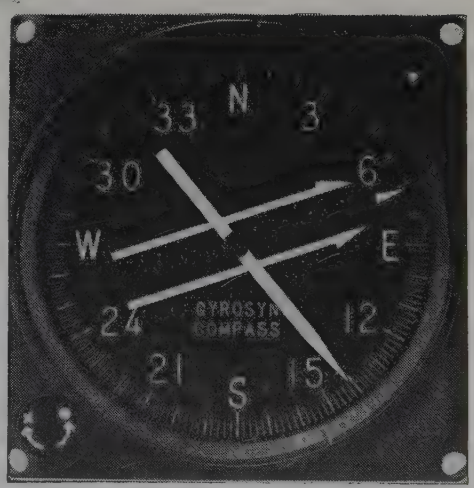


## By Harvey A. Senior




**GYROSEN C-2A** *(left)* has a rotating dial which is read against lubber line at top. Reciprocal heading is shown on the small lower dial

**GYROSEN C-2** *(right)* has fixed dial, rotating pointer. Course indicator is set to heading, plane turned until pointer lines up



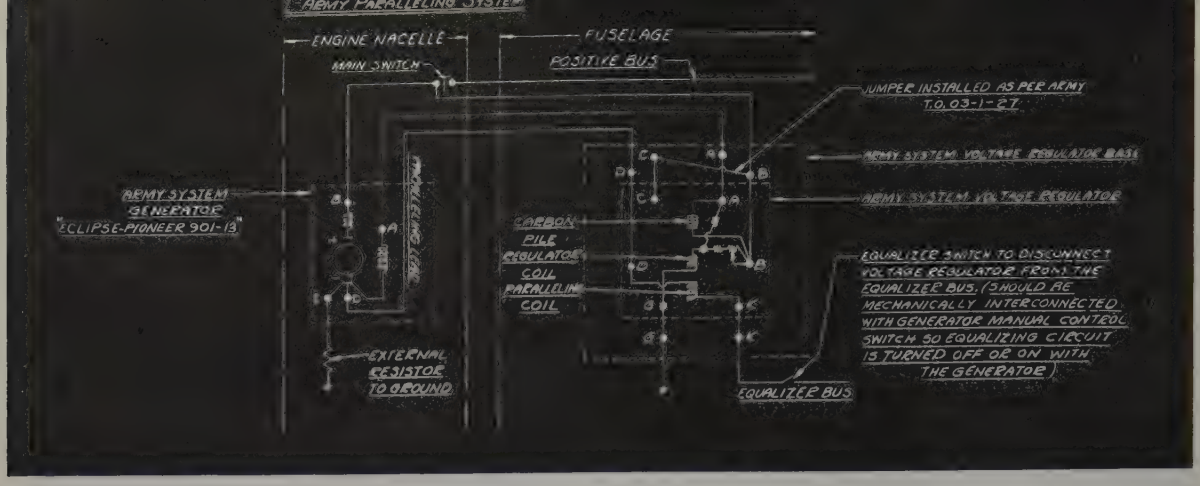
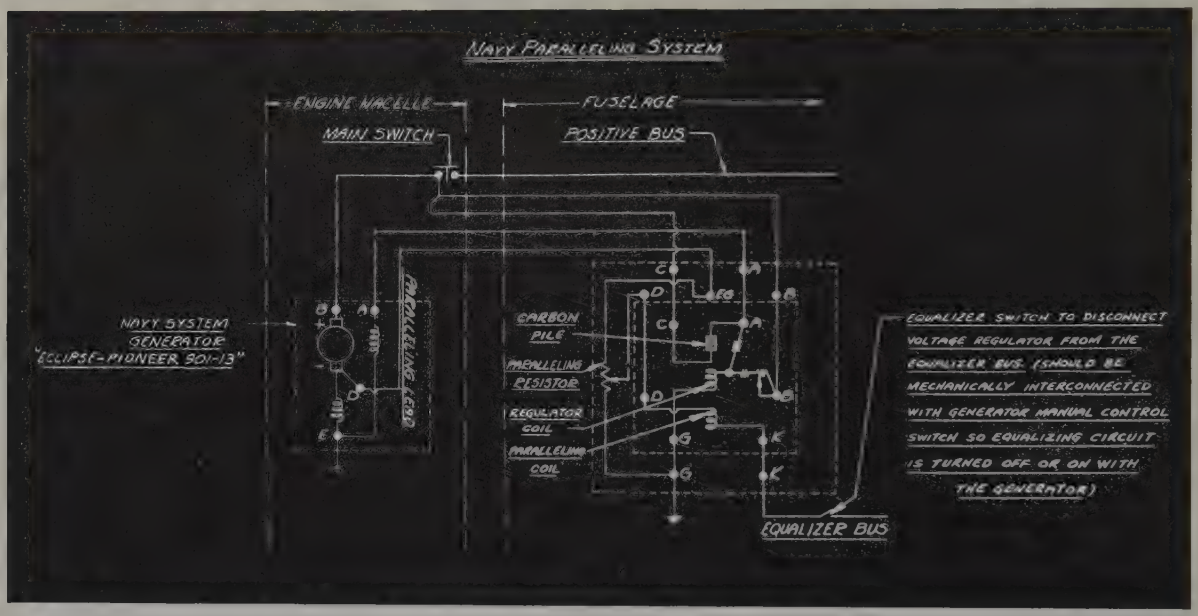

ARMY PARALLELING SYSTEM
ENGINE NACELLE
MAIN SWITCH
FUSELAGE
POSITIVE BUS
JUMPER INSTALLED AS PER ARMY T.O. 03-1-27
ARMY SYSTEM VOLTAGE REGULATOR BASE
ARMY SYSTEM VOLTAGE REGULATOR
ARMY SYSTEM GENERATOR "ECLIPSE-PIONEER 901-13"
PARALLELING LEAD
CARBON PILE REGULATOR COIL
PARALLELING COIL
EXTERNAL RESISTOR TO BE FOUND
EQUALIZER SWITCH TO DISCONNECT VOLTAGE REGULATOR FROM THE EQUALIZER BUS. (SHOULD BE MECHANICALLY INTERCONNECTED WITH GENERATOR MANUAL CONTROL SWITCH SO EQUALIZING CIRCUIT IS TURNED OFF OR ON WITH THE GENERATOR)
EQUALIZER BUS

**FIG 1**—Wiring diagram *(above)* is for the Army system of paralleling. In this system external resistors provide .5-volt drop. This drop is used as paralleling signal

**FIG 2**—Navy system of paralleling (wiring diagram *below*) utilizes interpole and compensating windings to obtain the paralleling signal. This gives a stronger signal


NAVY PARALLELING SYSTEM
ENGINE NACELLE
MAIN SWITCH
FUSELAGE
POSITIVE BUS
NAVY SYSTEM GENERATOR "ECLIPSE-PIONEER 901-13"
PARALLELING LEAD
CARBON PILE
PARALLELING RESISTOR
REGULATOR COIL
PARALLELING COIL
EQUALIZER SWITCH TO DISCONNECT VOLTAGE REGULATOR FROM THE EQUALIZER BUS. (SHOULD BE MECHANICALLY INTERCONNECTED WITH GENERATOR MANUAL CONTROL SWITCH SO EQUALIZING CIRCUIT IS TURNED OFF OR ON WITH THE GENERATOR)
EQUALIZER BUS

# d.c. Generators in Aircraft Systems

***The d.c. generator is the heart of an airplane's electrical system***

In the operation and maintenance of such aircraft as the popular DC-3, the Lockheed *Lodestar*, and the Twin-Beech used by corporate and private owners, the mechanics and pilots of those aircraft should have a sound knowledge and appreciation of the electrical fundamentals and recommended practices prescribed by the equipment manufacturers and the operations departments of the airlines.

In numerous instances war-surplus airplanes have been converted to deluxe passenger carriers with little thought given to the modernization of the electrical system. With the addition of many new units, added for the safety and comfort of the passengers and crew, a hazardous condition may develop. A real hazard does exist when the addition of new electrical units boosts normal operating requirements beyond the capacity of one generator. Loading will eventually cause the complete destruction of the generator.

Whenever alteration of the electrical system is

contemplated, a check should be made to determine the minimum requirements for extreme operating conditions. This can easily be accomplished by totaling the current demand of all units needed under such conditions. Compare this total with the total electrical energy available during single-engine operation. Do not rely too much on minimums that will require turning off numerous units scattered throughout the cabin and galley. If these units were considered sufficiently essential to be installed, be certain one generator can handle the load with a safe margin. Also, remember that greater current demands require larger wire sizes to insure the safe handling of maximum loads. (This will be discussed further in subsequent issues of SKYWAYS.)

Few of the generators manufactured during the last war have a sufficient capacity to handle the requirements of present-day aircraft. Those that have sufficient capacity should be placed in good operating condition before installation. This can best be accomplished by a complete overhaul and modernization in a service station authorized by the manufacturer. These shops will have the factory-trained mechanics, complete service instructions, replacement parts and manufacturers' bulletins necessary to insure the operator of a reliable unit.

Overhaul is a wise investment. Experience shows that lubricants used in generators bearings have a tendency to dry out after a shelf life of one year or more. Therefore, overhaul is recommended for new units which have been in storage for some time. In regard to war-surplus units, the cost may exceed the market value of the unit but its worth is genuine.

The d-c generator is the heart of the electrical system of the aircraft. It is the source of power for the operation of the electrical equipment and for charging the batteries.

The generator is self-excited and has a shunt-connected field coil. When the engine-driven armature is rotated within the yoke and field coil assembly, the armature coils cut the residual magnetic field existing in the magnetic circuit of the generator. The small voltage induced in the armature coil is transmitted to the shunt field through the brushes.

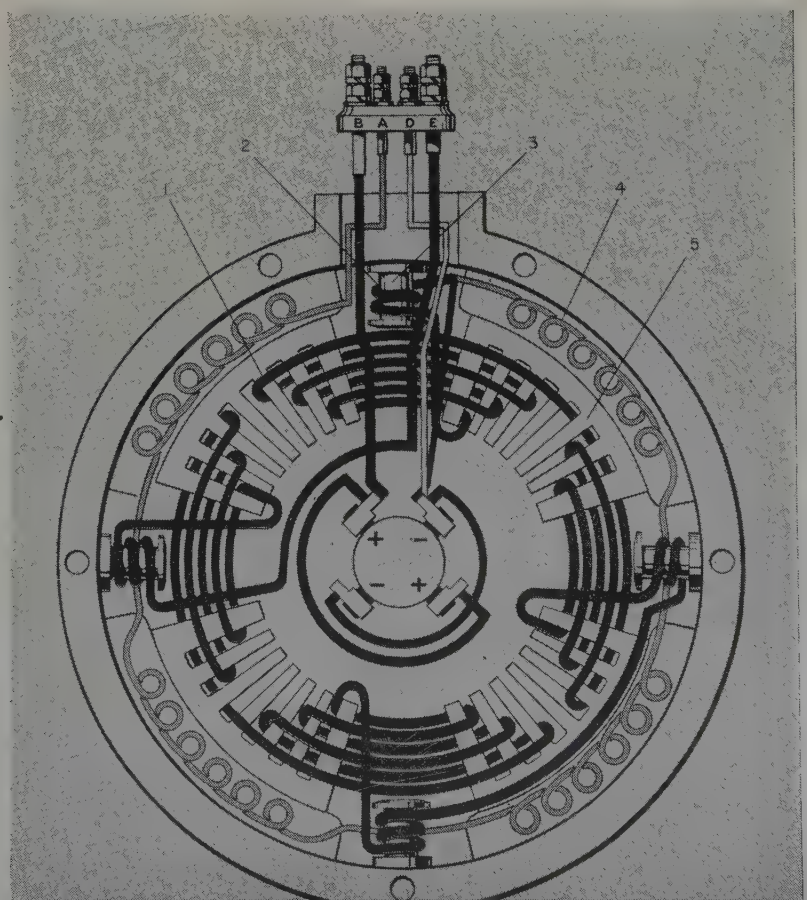
The small armature coil voltages initiate a flow of direct current through the field coil assembly (since the generator is not connected to the bus at this time), increasing the intensity of the magnetic field. Increased field intensity, in turn, causes higher induced voltages, increased field current and a still higher field intensity. Since the value of the induced voltage is also proportional to the speed of the armature rotation, generated voltage continues to build up as the speed of the generator increases.

When the generated voltage reaches a value coinciding with the setting of the voltage regulator, the regulator prevents further increase in field current, maintaining a constant generated voltage by automatically adjusting field-circuit resistance.

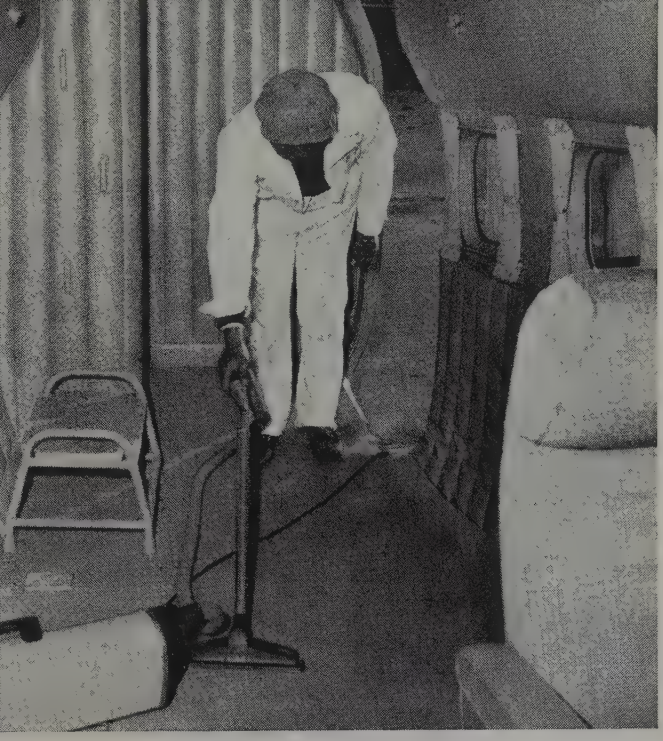
Higher capacity generators are usually provided with interpole and compensating windings to neutralize the magnetic fields normally developed in the armature coils when load current flows through them. Distortion and decrease in the main magnetic field, produced by the (*Continued on page 46*)

**By H. J. Pyle and R. P. Mosley**

***Eclipse-Pioneer Div., Bendix Aviation Corp.***




**SCHEMATIC** shows internal wiring diagram of a Type 914-15-A generator: 1—Compensating winding; 2—Interpole winding; 3—Interpole; 4—Shunt field coil assembly; and 5—Pole shoe



**FIRST STEP** in keeping a company plane clean is to carefully vacuum the interior, as on this *Lodestar*

# Corporate-Plane Cleaning

***Whether it's big or small, the best way to clean a plane is to scrub it***


## By Galen P. Potter

*Asst. Mgr., AiResearch*

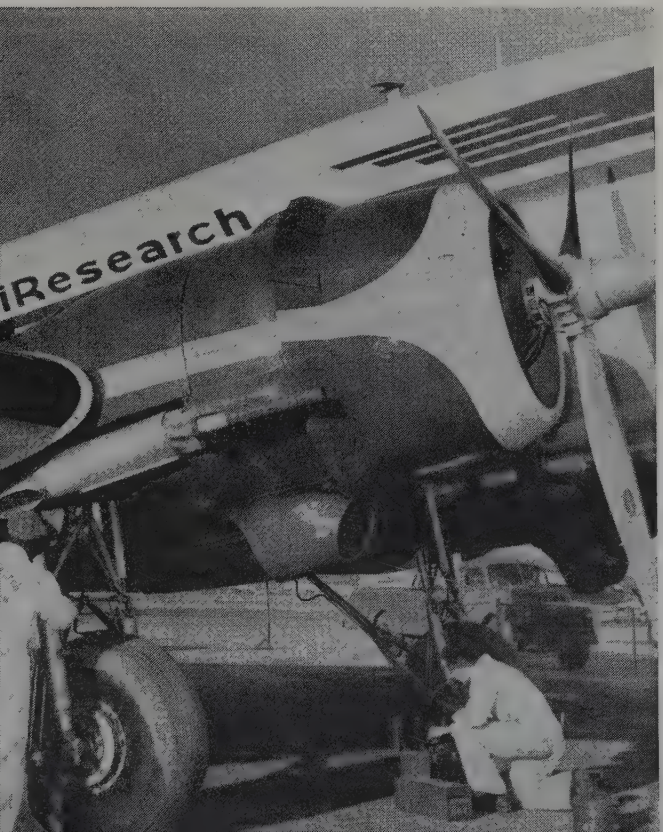

There is an old-time circus slogan that goes. "If you want a big job, go wash an elephant."

Our postscript to that is "If you want a bigger job, try washing a transport airplane."

There is a lot more to keeping an executive transport clean than parking it out in the open and praying for rain. You can't keep the company's airplane spotless by flying it through a rain storm on each trip. The only way to keep that airplane glistening—whether *Cub, Bonanza* or DC-6—is to put it on a wash rack, scrub it down with soap and water or some of the newer cleaning agents. Then flush the whole thing off with water, let it air-dry and polish it.

Many a pilot has tried to do an in-flight wash job with a damp cloud. If his airplane flew at less than 150 mph, all he got out of the dousing was a little actual instrument time and a badly streaked airplane. If the airplane was much faster than 150 mph, he shed the paint from all the leading edges.

**EXHAUST** stains are removed by hand. Best tools are a stiff brush, a strong arm. Some solvents are used

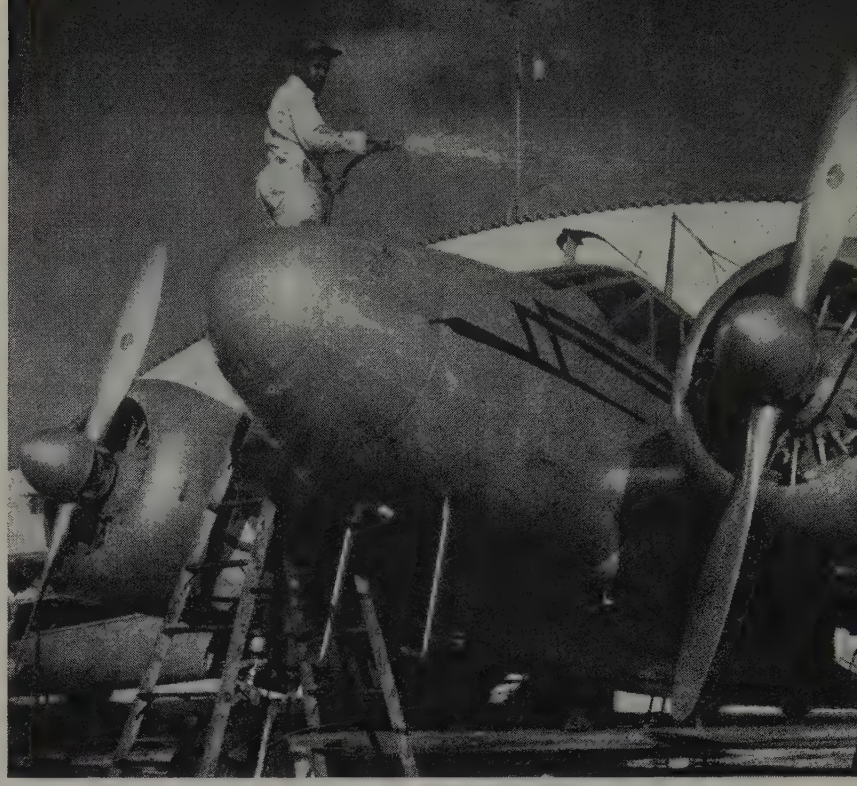



Let your bright and shiny airplane sit out all night and that gloss is going to take a beating. Here at the Los Angeles International Airport the smog will un-gloss an airplane in a hurry and most busy towns have the same trouble as the smoke, salt air, moisture and dust collect on the planes.

Sure cure for the over-night parking problem is to put the airplane in a hangar—that is, one without birds. Sparrows and pigeons seem to enjoy ducking out of the elements and nesting in the tops of aircraft hangars. Their droppings are sheer murder on a paint or polish job because the natural acids start etching at once. The best cure that we've found for these hangar pests is a 22 rifle, bored smooth, and a small 22-cal shot-shell. This load is effective up to 40 feet, yet does not have enough velocity to put holes in the roof or dent fabric surfaces with falling shot.

The problems of cleaning aircraft must be divided into two separate groups: 1) painted and 2) unpainted airplanes. We can steam-clean, soap and

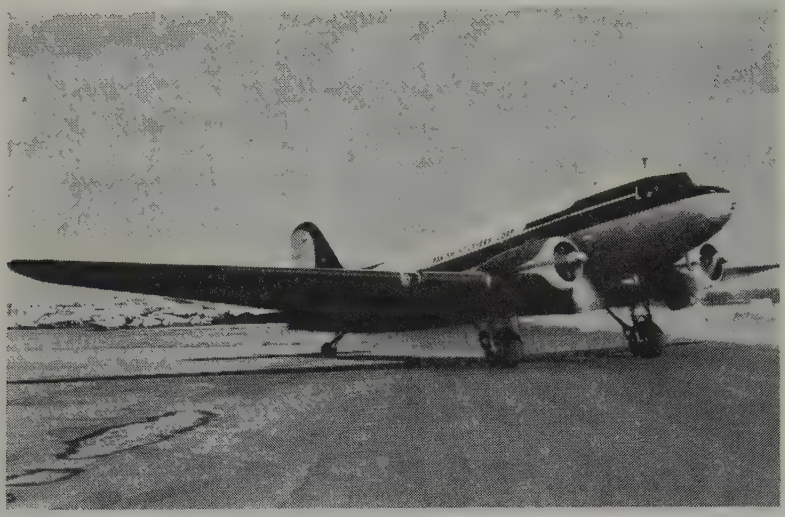
wash a moderately dirty painted DC-3 in about 30 man-hours. An unpainted DC-3, on the other hand, can really run into money to clean. It will take from 24 to 30 man-hours to clean up the metal with some of these new chemical cleaners like Turco or Cee-Bee. Then it can run another hundred hours to hand-polish the airplane. Washing streaks do not show up on a painted airplane the way they do on the natural aluminum surface and the painted plane does not have to be rubbed down by hand. That's why we recommend that our customers have their airplanes painted. The $2200 to $2500 cost of painting a DC-3—including the artist's design work—will pay for itself within nine months to a year if the airplane is kept in good condition. A DC-3 will pick up only 60 to 80 pounds in weight by painting and a good job should last for two years. Then a touch-up will cost only about half the original fee.



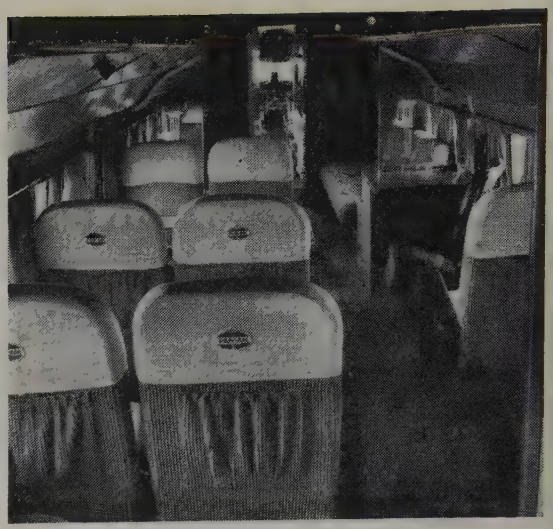
**CHEMICAL CLEANERS** are recommended for unpainted aircraft. Plenty of water must be used to flush off the cleaner from the top down

If an airplane is really dirty from salt air corrosion and general weathering, it should be gone over with a good chemical cleaner like Turo or Cee-Bee Alumaloy. There are several good cleaners for aluminum on the market, but be sure and check that the chemical you use has an AN approval for aircraft use. Some older cleaners seriously affect the metal in cracks and hard- (*Continued on page 38*)

**ENGINE NACELLE** of this Twin-Beech gets a good cleaning via chemical solvent put on by a long-handled brush. Be sure to keep the tires as free from grease and oil as possible. Rubber deteriorates from exposure to lubricants



**1952**—Pan-Am Southern Corp today owns and operates an executive DC-3. It seats 16 and features couches that can be made into beds, a writing desk, etc



**CABIN** of the DC-3 has Generco wood floors, and interior upholstery of an imported wool, leather

# SKYWAYS for BUSINESS

***News notes for pilots and owners of the 8,000-plus airplanes for business***

## CAA Warns Exec Operators of Difficulty with New Gas

Changes in the lead content of gasoline now prescribed by the Petroleum Administration for Defense may cause difficulties in airline-type engines, according to a warning by the CAA to users of such engines. The Petroleum Administration order requires that all commercial aviation gasoline of higher grade than 80 octane shall contain at least 4 milliliters of lead per gallon. All such fuel made available for use at foreign bases shall contain at least 4.6 ml per gallon. An exception is made in the case of 100/135 aviation fuel in that operators requiring use of this fuel may continue to purchase it, with not more than 3 ml of lead per gallon, upon application to and approval by the Petroleum Administration for Defense. The mildly leaded 80 octane gasoline will cause no difficulties, but operators of many low- and medium-powered large engines are warned that three adverse conditions may arise: there will be increased deposits from combustion products; there may be increased deposits in oil passages and on the interior surfaces of the engine; there may be increased supercharger and induction system deposits; and operators should not use fuel that has been stored for a long time under hot conditions because evaporation is likely to have caused an increase in its specific lead content.

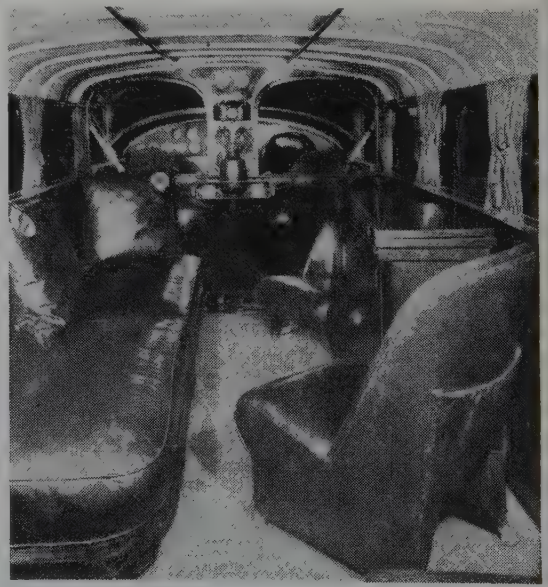
The CAA has issued Aviation Safety Release No. 355 to warn of these conditions and to suggest means of avoiding difficulties.

## Aero Commander Gets Its ATC; Goes on the Market

The Aero *Commander,* a new twin-engine executive transport designed and built by Aero Design & Engineering Co., Oklahoma City, has been granted its Approved Type

**1928**—Pan-Am Southern Corp operated its first executive airplane, a Sikorsky S-38, in 1928. This is believed to have been the first executive plane

**CABIN** of the Sikorsky, called "luxurious" in its day, seated five. Note its couch and two chairs



Certificate by the Civil Aeronautics Administration. The airplane is now in full production and, according to plans, at least 100 of the 200-mph light transports will come off the lines in 1952. First deliveries will be made to those who placed advanced orders accompanied by substantial deposits.

While the sale price on the advance-order basis, set prior to the determination of complete production, was $49,000 FAF, the new price, for all sales from February 1 on, will be $66.000 FAF, Tulakes Airport, Oklahoma City, Oklahoma.

## H-2 Non-Flammable Hydraulic Fluid Gaining Favor

At a recent Transport Aircraft Hydraulic Conference held in Detroit (*reported in SKYWAYS, March, 1952*), a rather pessimistic picture was painted relative to the availability of a non-flammable fluid which would operate successfully in present-day aircraft hydraulic systems. According to a later word, the Navy's experience with the Hollingshead H-2 fluid in military aircraft hydraulic systems has proved conclusively that it can and does operate successfully, and meets the exacting demands of the Navy's Bureau of Aeronautics. The Navy now has H-2 installed in about 1700 airplanes, and the word is that all aircraft are to be converted to H-2 as soon as feasible.

In addition, several airlines and executive aircraft owners are service testing H-2 in their aircraft. One airline has accumulated over 3,000 hours of flight time in a DC-4 type, and the company feels that the operation with H-2 has been remarkably trouble-free. With H-2 it is not necessary to change O-ring seals. In fact the standard-type seals now being produced to meet AN Specifications do a better job of sealing with H-2 than they do with the petroleum fluids. The Hollingshead Corporation is certain that when service tests are completed, the results will prove that H-2 will operate satisfactorily in present-day aircraft, thus adding to safety.

## Spartan To Stock Parts For DeHavilland Dove

Welcome news to the increasing number of De Havilland *Dove* owners is the announcement that Spartan Aero Repair of Tulsa, Oklahoma will soon carry a complete stock of parts for this popular British airplane. An initial consignment of from $10,000 to $12,000 in *Dove* and *Gypsy* (engine) parts is scheduled to reach Spartan's Tulsa plant in the very near future.

## Executive-Plane Sales Reach New High Point

Sales of multi-engine transport aircraft for executive and industrial aid users reached a new peak recently, if the activities of one sales firm is any indication. The New York firm of William C. Wold Associates, which conducts a transport aircraft clearing house servicing airlines and industrial aircraft users, announced a record sales-volume in January. Nine twin-engine transports of seven different types were sold during the month. Except for one DC-3 and a Convair *Catalina* sold to an airline, all of these planes will be used as executive transports or industrial aid aircraft.

## . . . in the Corporate Hangar

Odessa Natural Gas Company's *Lodestar* is in the shop at Executive Aircraft Service for 100-hour check. At the same time Associated Radio Company is modernizing the ship's radio gear. Pilot of the *Lodestar* is Ray Hodges. His boss, Odessa's prexy W. D. Noel, flies his own *Bonanza* around the company's area of operations.

Pilot Barney Evart and co-pilot Phil Kaufield flew the Pacific Lumber Company's executive B-23 to Pacific Airmotive for modification and repair. Bob Chambers, one of Pacific Lumber's mechanics, is seeing the ship through the work.

Cappel, MacDonald & Company, of Dayton, Los Angeles, New York and Detroit, recently bought an executive *Lodester* from Powers & George. The plane formerly belonged to orchestra-leader Vaughn Monroe, later was owned by Central Ermita at Oriente, Cuba (this company now flies a De Havilland *Dove*, with Henry Kent as pilot). Cappel, MacDonald & Company also operates an executive Twin-Beech. Chief pilot who'll handle the *Lodestar* is Jack DeWolfe.

Shamrock Oil Company has named Warren Heckman as pilot of the company's Twin-Beech. The ship is based at Amarillo, Texas.

Johns-Manville's DC-3 has been in the hangar at The Babb Company, Newark, for repairs. Bill Vanderkloot brought the ship in when an oil leak developed in the right engine.

Koppers Company's DC-3 was brought to AiResearch for an engine change, rework on the heating system, 1,000-hour inspection and the installation of new type windshield and cabin windows. Col. Byron O. VanCott, pilot, John Hayward, co-pilot, and Mike Pristas, flight engineer, flew the plane West.

A De Havilland *Dove* is now being operated for business purposes by Helmerich and Payne Drilling Company, Tulsa. The *Dove* was in the Spartan Aero Repair shop for an exterior paint job, installation of new leather armrests and minor repairs. The Helmerich and Payne Drilling Company also operates an executive Twin-Beech.

Character Foundations, of New York City, has had the company *Bonanza* in the shop at Atlantic Aviation for installation of a Lear L-2 autopilot.

Al Ueltschi, Pan Am pilot, should be a Boston Braves fan by the time his aerial tour with the "Boston Braves Rookie Rocket" is completed. The Boston Braves leased the B-23, complete with pilot, from Pan American for a gathering of the clan of Boston rookies for the 1952 baseball season. Before leaving on the trip West, Al had the ship at The Babb Company for repair of oil leaks in the oil coolers.

Stanolind Oil and Gas Company's A-26 #164 is being given the full treatment at Spartan Aero Repair: new *Double Wasp* engines, new exterior paint job (Stanolind blue and gray with white top), and a completely new interior (turquoise and gray).

Parker Pen Company has taken delivery of its new PV-1, and it's a beauty. Pilot Lee Haynes and co-pilot Bob Hansens, who brought the ship into New York on a sort of shake-down trip, made the flight from Janesville, Wisconsin to Teterboro, N. J. in 2 hours 50 minutes. Interior was designed by Maria Bergsan of the Henry Dreyfuss office, and the work was done by Remmert-Werner, St. Louis. Interesting details of this executive plane will be available soon.

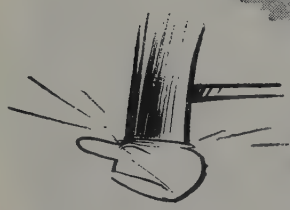
Minneapolis Honeywell's DC-3 is in the shop at AiResearch for installation of a new executive interior, oxygen system, new cabin airstair door and a new heating system. Larry Alberts, supervisor of the company's flight operations, brought the plane in.

Vic Swanson and Tom Van Sickle herded their Sears, Roebuck & Co. DC-3 through a 100-hour check and a new radio installation at Executive Aircraft Service's shop at Dallas. Associated Radio stripped the Douglas of all radio gear, reracked and provided it with modern design and installation, and added a Collins omni, 18S-1. Upon completion of the work, the boys flew the plane to Caracas, Venezuela, on business.

"Dilberts always travel in the circle of confusion . . . Careless cockpit cousins on the skyroad to confusions"

# DILBERT

## By S. H. Warner and R. Osborn



**Metamorphosis of a Navigator**—Some pilots learn by study, others by observation, but some learn only the hard way. Those are the Dilberts, of course.

A review of the circumstances under which Dilbert got himself lost on a navigation flight at sea may help prevent some less lucky pilot from pulling the same boob trick.

Dilbert was flying a two-place, single-float job, and had along an amateur radio operator—very amateur. Surface wind at point of departure was 15 knots from 45°. Dilbert had the radioman take a drift sight when they got to 2,000 feet. He reported the wind was 35 knots from 127°.

Using this wind, our hero went blithely on his way.

This was his basic error—very basic indeed. For the amateur radioman was also a novice with the drift sight. And Dilbert should have known this. Anyway, knowing the surface wind, he should have been suspicious of the wind reported at 2,000 feet.

We pick up our unsuspicious pilot again four hours later, when his flight should have been completed. He wasn't quite so blithe now, for there was no land in sight. As one wag put it, he was completely "at sea."

At this point, Dilbert began to doubt the accuracy of that drift sight, and reworked his navigation, using the original surface wind. This put him approximately 50 miles south of his base.

He then requested his radioman to take a direction finder bearing of the base. This was reported as 214°. But the radioman wasn't any more skilled with the direction finder than he was with drift sight.

Our pilot did question (*Continued on page 57*)

# Nathaniel F. Silsbee

**1896 1952**

On February 15th last, the Corporation Aircraft Owners Association was deeply saddened by the passing of its Executive Secretary, Nathaniel F. Silsbee. In grateful memory of Colonel Silsbee, the Association unanimously adopted the following resolution:

*"This Board desires to make permanent record of its great loss in the recent death of Nathaniel F. Silsbee, affectionately known to us as 'Neil.'*

*"He became Executive Secretary of the Association in 1949 and served in this capacity until his death.*

*"His background of aviation experience and his ability to present and discuss the problems of the Association with representatives of Federal and local governmental agencies and of other associations and organizations was of great benefit to the Association. The Directory of Executive Aircraft which he originally prepared and, from time to time revised, represents a continuing memorial to his energy and care. In all matters relating to the business of the Association he was conscientious and reliable.*

*"In all personal relations he was kindness itself; he was of a most engaging nature, a warm and firm friend of us all.*

*"To his family we desire to express our deep sorrow at his loss and our sincere sympathy."*

SKYWAYS joins with the Corporation Aircraft Owners Association in expressing its sorrow at losing a friend and associate. Col. Silsbee was for several years Technical Editor of SKYWAYS, and during his tenure of office with the Corporation Aircraft Owners Association continued to work closely with the SKYWAYS Editorial staff in the development of executive aircraft operation and management. A native of Dorchester, Mass., Col. Silsbee served in 1946 as governor of the New York Chapter of the Aviation Writers' Association. He won the Trans World Airlines technical writing trophy four times, and his contributions to engineering and aviation magazines enjoyed wide readership. A private in World War I, he was a lieutenant colonel of Air Staff Intelligence in the last war and was promoted to full colonel in the reserve upon his discharge from the service in 1945. During a varied career, Col. Silsbee was a newspaper columnist and also spent 14 years as a missionary in India.

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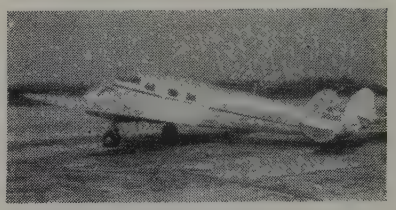
**CESSNA TWINS—16 FOR SALE—** #5462TS has 250 hours since aircraft, engines, and propellers overhauled. Recovered 1949. Raised floor. Outside baggage door. New tires. Flares. Gyros. Collins ADF. Extras. Undamaged. Exceptional. $2750. Consult **POWERS & GEORGE.** "Airplanes Everywhere."

**CESSNA 170's—17 FOR SALE—**1948, #408SVS, has only 225 total hours. Metal propeller. Gyro compass. Radio. $3700. Also; 1950 all metal, #979SAS, with only 246 hours. Metal propeller. Gyros. Narco Omni-range. Extras. Bargain. $6,000. Consult **POWERS & GEORGE.** "Airplanes Everywhere."



**LOCKHEED 12A'S—4 FOR SALE—** Corporation owned, #400SS, has 193 hours since aircraft, engines, and hydromatics major overhauled. Auxiliary tank. Deicing. Reupholstered. Excellent radio. Original owner. Beautiful bright clean condition. $30,250. Consult **POWERS & GEORGE.** "Airplanes Everywhere."

**BEECHCRAFT BONANZAS—22 FOR SALE—$6750 UP.** October 1949 painted model A-35, #872ZAS, has 250 total hours. New 205 hp. engine. Auxiliary tank. Gyros. VHF transmitter. Hangared. One owner. New condition. $12,000. For details and inspection consult **POWERS & GEORGE.** "Airplanes Everywhere."

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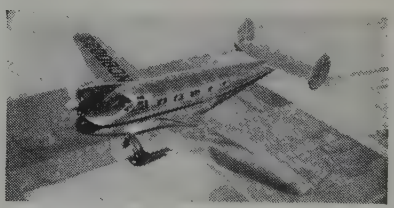
**NAVIONS—31 FOR SALE—$4,400 UP.** Late 1948, #441QKS, has only 250 hours. Latest 185 hp. engine. Heater. Gyros. ADF. Extras. $6,950. Also; 1949, 205 hp., #495QKS, with only 325 hours. Latest prop. Extra tank. Gyros. Omni. ADF. $10,800. Consult **POWERS & GEORGE.** "Airplanes Everywhere."

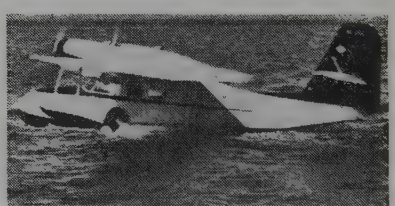
**GRUMMAN GOOSE AMPHIBIANS—3 FOR SALE—**Executive, #6837PS, has 1150 total hours. Engines and constant speed propellers major overhauled. Electric gear. Divan. Chairs. Coat closet. Good radio with ADF. Exceptionally fine condition. Bargain. $37,500. Consult **POWERS & GEORGE.** "Airplanes Everywhere."



**BEECHCRAFT D-18-S TWINS—13 FOR SALE—$40,000 UP.** 1946, #8017RS, has constant speed props, best equipment, deicing, and 3 zero engines. $55,000. Make offer. Also; 1946 Executive, #63PS, with hydromatics, best equipment, deicing, and 2 zero engines. $67,500. Consult **POWERS & GEORGE.**

**1948 STINSON 165'S—12 FOR SALE—$2,750 UP.** #683PMS has 395 total hours. Goodyear crosswind gear. Recovered. Corrosion proofed. Metal propeller. Gyros. Special compass. VHF transmitter. Always hangared. Beautiful. $3,500. For details consult **POWERS & GEORGE.** "Airplanes Everywhere."

**SWIFT 125'S—15 FOR SALE—$2000 UP.** 1951, #245QVS, has only 157 total hours. Aeromatic. Primary blind instruments. Radio. Manifold pressure. Cylinder head temperature. Seat covers. Undamaged. Hangared. One owner. New condition. Bargain. $3500. Consult **POWERS & GEORGE.** "Airplanes Everywhere."



**GRUMMAN WIDGEON AMPHIBIANS—4 FOR SALE—$13,550 UP.** G44A, #4197QS, has 850 total hours. Engines 220 hours since O.H. Beech controllable propellers. Gyros. VHF. ADF. Beautiful. 3 extra engines. 6 extra propellers included. $25,350. Consult **POWERS & GEORGE.** "Airplanes Everywhere."

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# Close Support in Korea

(*Continued from page 11*)

foxholes have no way of knowing the strategic results of the over-all close support picture. They do know the importance of close-support air strikes when the enemy horde attacks, and they know the importance of close-support air strikes when the enemy fanatically defends a ridge-top. They know the importance of close-support air strikes when a bullet or piece of shrapnel finds its mark.

Ask them and they will tell you that a close-support air strike is something that just comes out of the sky when it is needed most. How it happens or where the jets come from means nothing to these fighting men. They are satisfied to know only that the planes are around when help is badly needed.

Remember Chosin Reservoir? The Marine 1st Division was cut off from the Army's 7th Infantry and the call went out for close support. Without the round-the-clock battering by the Fifth Air Force planes that answered the call, many of the evacuation troopships that filled the harbor might never have been needed.

Reported Jack Burby of United Press, "The ones I talked to were not bitter, they just wished there had been more Marines up there and those on one truck swore they were 'Gonna buy free beer for Marine, Navy and Air Force pilots.' Sergeant Frank Reynolds, a husky reservist from Cranford, N. J., said, 'We'd still be up there fighting the bastards if it hadn't been for the planes.'"

To the front line soldier close air support may seem to be a gift from Heaven, a magical appearance of invincible strength. While close air support may well be termed a gift, it is not by any sense of the word magical.

In a hypothetical case a numbered Air Force commands all fighter planes, fighter bombers and light bombers operating against an opposing enemy. Heavy bombers, because of their limited operational versatility, let us say, respond to orders from a bomber command headquarters.

So, we have fighter bombers and light bombers to range the enemy's immediate rear areas, striking at supply routes, cutting the arteries before blood from the heart can reach the pounding fists. Fighters, meanwhile, feinting the reaching enemy fists, are jabbing him repeatedly around the head and shoulders. Keeping in mind that our hypothetical air power need not pull any punches and is free to hit any vulnerable spot that can be reached, the medium and heavy bombers are pounding the enemy's heart.

Where does close air support enter the picture? It enters through the medium of joint operational control of ground and air forces. A coordination, either needed or planned, is maintained constantly in conjunction with an over-all picture of the entire front. Herein lies the secret of the success of the U. S. Air Force's close-support program in the Korean war. Complete control of all close-support planes by the numbered air force has allowed a flexibility that is constantly building the pillar of ink on the operational graph that indicates enemy losses.

It is flexibility, the controlled flexibility by air force specialists working hand in glove with ground force specialists, that has placed the close-support air strike where the front line warrior needed it *when* he needed it.

Because of this flexibility, warplanes are not tied to a single hitching post. Nor is there a duplication of carriers that could easily call for a change of horses in midstream. And in comparing the enemy thrust to a raging, flood-swollen river, the importance of a single, stable carrier that fords the current at any point, is readily seen.

But the basic success of close air support is not seen merely as a matter of coordination or flexibility, nor as an ever-increasing line on a chart. As in every fight, it is the human element that brings about the decision. And it is the manner in which a man uses his weapons—and the strength of those weapons—that is the determining factor in the battle.

First, consider the weapons with which our Air Force fights. In this Korean war, which is heralding the end of propeller-driven fighter planes, the versatile, all-purpose jet has carried the brunt of the close-support mission.

Pick a jet, any jet—the F-86 *Sabrejet*, the F-84 *Thunderjet* or the F-80 *Shooting Star*. There are others but these three have dominated the Air Force program during present hostilities. The *Sabrejet* has repeatedly battled the enemy's best jet to a standstill. The *Thunderjet* and the *Shooting Star* have been the support program workhorses. Equipped with 500- and 1,000-pound bombs, they have smashed supply routes. Armed with rockets, napalm and 50-cal ammunition, they have written a new chapter in the comparatively young history of close air support.

Speedy, rugged and dependable, these aircraft are ideally suited to close air support work—not by virtue of their speed alone, nor by their strength or dependability, but by virtue of the fact that they are the latest type of jet aircraft capable of not only getting the job done but of being able to meet the latest type of enemy plane on an equal footing. U. S. Air Force pilots know that the air superiority they now enjoy may not always exist.

For example, on the 6th of September 1951, two of our obsolete and unarmed T-6 Mosquito planes were attacked by enemy fighters while directing front-line close air support missions. Capt. George E. Lougee, 699 Broadway St., Bangor, Me., a T-6 Mosquito pilot, was attacked by a Communist Yak-9 aircraft near Kumsong. On the same day Capt. Paul Roberts of Concord, N. H., another Mosquito pilot, was also attacked by a Yak-9 near Chorwon. On Sept. 10, while directing close support air strikes near Kosong, Capt. William A. Liddy, Jacksonville, Tex. and his ground force observer were subjected to a firing pass by another Yak-type enemy plane.

These pilots and observers flying their missions in clear weather or foul among the sharp peaks of the Korean battlefront areas are typical of the men who make close support air strikes possible.

On the other hand, operating quietly and efficiently are a group of infrequently mentioned airmen. They are the tactical air control parties that coordinate air-ground activities at the front. Working and living under battle conditions with the infantry are the men of the U. S. Air Force's 6150th Tactical Control Group. A small but highly specialized group of radio operators and maintenance men, they are unofficially the Air Force Infantry in Korea. Equipped with radio jeeps and portable transmitting units and headed by a combat pilot on temporary duty, these tactical air control parties (TACP) are assigned at infantry division, battalion and oftentimes company level. When the infantry moves forward, they move forward also, coordinating by visual means the air strikes that have saved many thousands of casualties and beaten down the enemy resistance that has many times meant the success of an allied attack.

Lt. Henry P. Seymour, Los Angeles, Calif., was recently assigned as a Tactical Air Controller with the Eighth Army's 7th Infantry Division. Seymour, a B-26 combat pilot from the 452nd Bomb Wing, was working with the "Spearhead" regiment of the 7th when it was assigned the mission of securing an important position on the then Kansas line.

The line companies ran up against stiff Communist resistance from a ridge controlling a road junction at the mouth of a pass. Lt. Seymour called in an air strike that poured napalm, rockets and hundreds of rounds of .50-cal bullets into the ridge on succeeding passes.

Then the infantry moved forward, taking the TACP with it.

Approximately 500 yards from the Redheld hill, Lt. Seymour, his radio operator and radio mechanic, Cpl. William E. Dent, Roanoke, Va., and Cpl. James F. Clutter, Washington, Pa., were operating their radio jeep and coordinating artillery and the low-flying planes.

Suddenly, a bullet cracked through the air. There was a dull thud and a sudden hissing. The three men made a dive for the nearest ditch.

"For a second I thought the hissing was some sort of a bomb that would explode any minute," said Lt. Seymour. "The noise finally died away and I looked up at the jeep.

"That bullet had hit a rear tire and torn a hole big enough to put your fist through."

Many of the battle experiences of the TACP's don't end so happily. Over 50 per cent of the men on the roster of the 6150th have either been decorated or recommended for decorations for their deeds of heroism on the front lines. Not a few of those men have been killed in action and many are prisoners of war. A few have been lucky enough to outrun the enemy.

Take the case of Cpl. James F. Clutter of Washington, Pa., a TACP radio operator. His party was cut off from friendly troops and he became separated from the rest of his group. For two days and nights he literally outran a group of pursuing Chinese Communists. He had joined forces with several South Korean troops and at various times during the two-day marathon, enemy bullets splattered into the earth around him and found their marks among the ROK soldiers. "I was never so scared in my life," he later admitted. "I learned how to run at top speed with my head tucked between my legs. I was lucky to get out alive."

Wherever the infantry might go in battle, a Tactical Air Control Party will go with them. Only recently a Tactical Air Control Party set up business in a tank. Lt. Lawrence L. Bray of Tampa, Fla., and his two radiomen trained several weeks with the crew of a General Patton M-46 tank. Operating from within the tank, they were to move forward with a spearhead drive.

From their vantage point at the very heart of the battle they could call close-support air strikes with infinite exactness. Cpl. Howard N. Cheserow of Noank, Conn., acted as leader for the tank's 90-mm cannon with his radio duties were not too pressing.

The desire of TACP's to venture anywhere they are needed and to face any danger in order to successfully complete a close air support strike is the glue which binds together the Air Force and the Infantry in Korea. In spite of numerous infantry wise cracks about the airmen at the front, there is a mutual respect between the men who fight and those who fight while helping them.

Widely known Col. "Buffalo Bill" Quinn of the 7th Divisions's 17th "Buffalo" Regiment, appreciates the Air Force men who come to work with him. He has decorated more than one of them.

And there is PFC Daniel Kelly, Lakeland, Fla., a member of a daylight patrol which was rescued from a Communist ambush by a hurriedly called air strike. He discovered the importance of close air support at the lowest echelon. Command decisions didn't phase him. He needed help and he got it. His squad leader, PFC Bennie Armijo of Albuquerque, N. Mex., expressed his thanks in true Americanism. "If my neck had been rubber, I'd have stretched it up and kissed each of those pilots!"

Lt. Nuri Koyuter of Istanbul, an officer with the Turkish Brigade in Korea, made a special trip to a front-line airstrip to express his thanks for a close-support air strike. Koyuter, son of a member of the Turkish Parliament, and his unit were being fanatically opposed by a group of Reds on an important ridge-top.

Lt. Charles B. Horten, Lynfield, Mass., was only one of several F-80 pilots who napalmed and strafed that ridge in support of Koyuter's men.

When the two United Nations officers met, Koyuter said he just "wanted to shake hands with one of the men who had been of such tremendous assistance." The Turks were able to occupy the Chinese position following the air strike.

Thanks there are aplenty, but perhaps one of the most famous expressions of gratitude to come out of the Korean close air support program was issued through the lips of a wounded soldier as he was waiting air evacuation to Tokyo.

"Boy," he said, "the Infantry sure has a big brother now, the Air Force." His remark was made on the occasion of an inspection visit by the Commanding General of the 452nd Light Bomb Wing, whose planes answered the call to Chosin Reservoir.

From this air force-infantry working agreement of helping each other, is developing a better understanding by each, of the other's problems. And this acceptance of each other's is apparently not happenstance. It is a logical result at lower echelons of top-level planning, for Air-Ground Operation is not the dream child of the Air Force alone. The official bible on this subject of "air-ground," Field Manual 31-35 and its counterpart, FM 100-20, bear the signatures, respectively, of ground force Generals Marshall and Eisenhower.

From top-level planning to the lowest echelon soldier in the foxhole, close air support is a matter of joint coordination and it is the success of this coordination between the two operations which has brought about the accomplishments of ground-air in Korea.

In Europe during the War II, the most dramatic close air support operation was the column-cover flank protection given to General Patton's Third Army in its "Right Hook" across France after the break-out of St. Lo.

And in Korea is a field artillery sergeant SFC Joseph Lockwood, Truskow, Pa., who is currently flying as an observer in the rear seat of T-6 Mosquito plane over the front lines. He is the ground force representative of the flying team that directs striking jet fighters to their close-support targets. He unwittingly summed up close air support in Korea from a fighting man's point of view while giving an account of his duties with the Army.

"I was with the Infantry in Europe and I'll never forget the flight of P-47's that broke up a German counterattack on the Elbe River and helped us break through. We had close support aplenty in Europe.

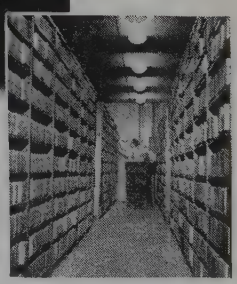
"Over here in Korea, before I started working with the Air Force, we were surrounded at Chipyong-ni and the planes dropped us supplies around the clock for three days. And those jets that gave us our close support really saved our necks.

"You can quote me on this close support stuff—the closer, the better."


Incomparable

a pretty girl

The Taj Mahal by moonlight... red sails in the sunset... the Isle of Capri at dawn... these and other fabled things pale into limbo against the dazzling splendor of milady's new bonnet on Easter morning. Stealing a peak in the mirror is Juanita Ransome, 26, hazel-eyed, brown-haired. She likes to ride horseback and has a Scotty dog named Smokey. (No. 7 in a series of pretty Dallas girls discovered and photographed especially for Southwest Airmotive).



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# Corporate-Plane Cleaning

(*Continued from page 29*)

to-get-at areas where the solution cannot be washed away. This new Cee-Bee product, however, can be timed with a stop-watch to see how long it works. Rub it on a wet aluminum surface with a rough brush and it will boil for two to three minutes, depending upon the temperature. Then the solution quits working and will not injure the metal by remaining, though the standard procedure is to wash it off after 10 to 20 minutes.

Since most of these chemicals are shipped in a concentrated form and need diluting, they should be applied only by personnel who have been thoroughly briefed in their use. Occasionally, we get an airplane in for an 8,000-hour overhaul and find such extreme etching and corrosion in the center section that the metal has actually been weakened. For that reason, if nothing else, use only AN aircraft-approved materials for cleaning. But after application, be sure to flush it off with cold water. Both Turco and Cee-Bee are recommended in the new Air Force tech orders.

If you plan to clean your own airplane, here's the way to do it: For a business-like job, clean and vacuum the inside of the airplane first. Otherwise, you will have dust from the inside scattered all over your new wash and polish job.

Use a steam cleaning unit, if one is available, to cut the oil and grease spots around the engines. Be careful that the live steam does not touch the ignition or other wiring circuits. If a steam cleaner is not available, use a petroleum solvent like cleaning fluid to cut the grease. Do *not* use gasoline or highly volatile solvents like paint thinner—even out of doors—because of the fire hazard.

This steam or solvent cleaning is usually needed around the engine nacelles and wheel wells. Keep the tires as free from grease and oil as possible because the rubber deteriorates and cracks from continued exposure to lubricants. To keep oil off the tires while the airplane is on the ground, many owners of Twin-Beechcrafts that have an oil overflow vent in the wheel well place a small can under this line.

An essential part of every wash job is a rinse around the battery and lead-in cables. Use a soda and water solution, applied with a stiff brush, to stop any battery acid corrosion.

After these essential preliminaries, you're ready to wash the airplane. If the ship is painted, a once-over-lightly with soap and water should do the trick. New detergent soaps, such as "Vel," are good, provided that they are thoroughly rinsed with water after application. Soaping should not be done in the hot sun or the results will be very badly streaked. The best washing results are obtained when the airplane is parked in the shade of a hangar—or when the job is done early in the morning or late in the evening.

This same soaping method will work for an un-painted airplane with fairly good results. The scum comes off, but after four to six months the airplane will take on a dark, dreary appearance because of the natural oxidation of the metal. Therefore, the unpainted airplane should be washed periodically with a Turco or Cee-Bee chemical cleaner. Application, as recommended by the Cee-Bee company, reads as follows:

**CUTLASS F7U-3** is larger, better equipped, harder hitting version of the F7U-1, first sweptwing tailless fighter to operate from the deck of a Navy carrier

"Wash excessively oily areas with Cee-Bee Alumaloy Emulsion. Mix one part Alumaloy with three parts solvent. Thoroughly agitate with air to form a creamy emulsion.

"Apply a liberal quantity of Alumaloy emulsion to oily areas by pressure spray. Agitate thoroughly with a firm bristle brush and rinse the cleaned areas with a large volume of water.

"Make a liberal application of Cee-Bee R-66 (surface brightener), dilution made from one part by volume of Cee-Bee R-66 and two parts by volume of water, to the surfaces to be brightened. This application can be accomplished by applying the diluted R-66 with pressure spray covering every square inch of the area.

"Go over the surfaces with a firm bristle brush, lightly but thoroughly, to assure an even coverage of the R-66 solution. This operation will be accomplished by working from the top down, working on the tail fin and tail surfaces first and then working forward by sections. Complete one section before moving to another.

"The time required for the solution to stay on the surface of the skin will be determined by the condition of the skin itself. It is usually left on the aluminum surface from two to 10 minutes. The time required in cold weather is greater than in hot weather.

"Precautions should be taken not to work too large an area, especially in warm weather.

"Rinse off dirt from the top down with a large free-flowing rinse using cold water. Be certain to rinse over an area that had been previously brightened. Agitating with a clean brush or mop while rinsing will assure excellent results.

"Allow to dry."

If the oxidation is heavy, go over the surfaces twice—or even more if necessary—using a firm bristle brush to mechanically remove the heavy oxidation that has been chemically loosened by the brightener.

About a year ago, CAA inspectors began testing the fabric control surfaces of some of the executive planes and they found that the cloth had gone "dead" in an unusually short period of time. This was due to using non-aircraft cleaners on or near a fabric surface. All the Turco and Cee-Bee material that we use is harmless to either metal or fabric.

Up until the last year or two, the approved method of making your metal airplane shine brilliantly was to polish it with a rotary electric buffer. For a large airplane, this method is quite expensive and the new chemicals usually do a more efficient job in much less time. Some owners used to have their airplanes cleaned thoroughly and then painted with a coat of clear lacquer. However, after three or four months, the whole job would begin to look pretty sad because the lacquer turned increasingly yellow.

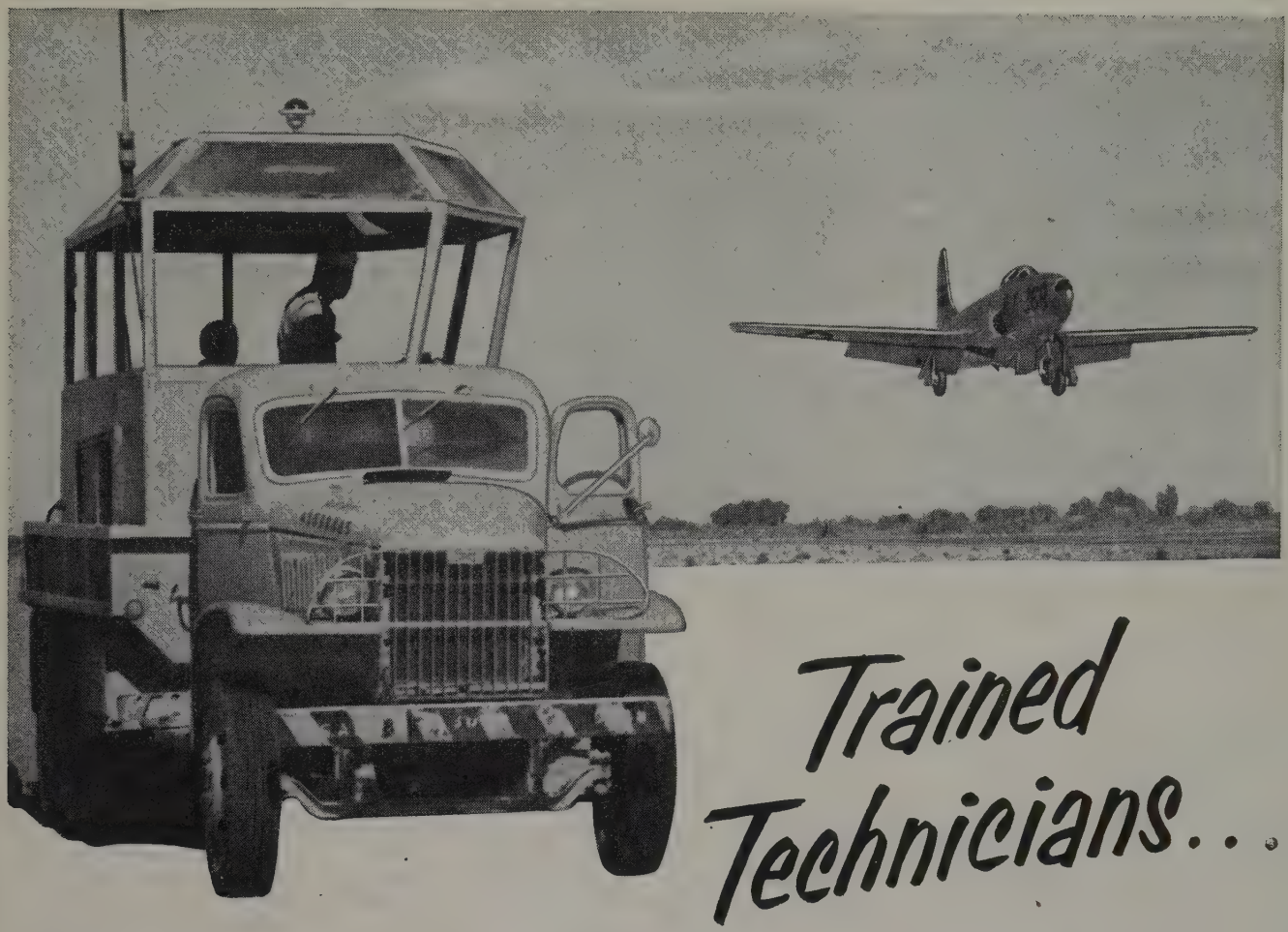
After the airplane has had a good chemical cleaning, we usually apply a light metal polish like "Klad" with a soft cloth. After it chalk-dries, the polish can be rubbed off easily with another cloth—and your airplane is ready for a show-room display.

There is little value in waxing the surface of a painted airplane. It takes a lot of time and the tough enamel surface of a painted airplane already has a good gloss and doesn't need an extra coat.

As a rule the canvas covers used by some owners are more trouble than they are worth. They will scratch the surface of the paint job while being put on or removed. Even the nylon covers for the Chicago *Tribune* B-17 are used only as a wing-ice protection when the plane is parked in the open during icing conditions.

Keeping an executive airplane glistening is a never-ending job. However, a good appearance is an important part of any business. The Indian Mahout who takes care of the elephants in the circus actually has a simple job compared with the operator of a big airplane when it comes to keeping things clean.

It's a big job, and the bigger the airplane, the bigger the job.



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Special skills expertly maintain the global operations of our expanding United States Air Force. It is special skills of trained craftsmen, behind the flying skills, that keep our modern air power aloft to defend our nation.

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# Airline Pilots...Safety

(*Continued from page 14*)

which while accidents declined slightly, fatal accidents continued at a high level. This we attribute to inexperienced personnel, both flight and ground, and to the general insecurity and pressure of that period.

The third period, 1946-50, is that of the introduction of postwar equipment, notably the wide use of four-engine planes for both domestic and international travel. This period is marked by a decrease in both rates, particularly the fatal one, followed by a definite level-off. Preliminary figures for 1951 confirm this stabilization, showing even a slight increase in both rates, particularly the fatal one.

One point of great significance to the pilots and one not generally appreciated is this. At the 1949-51 rate of accidents and present airplane speeds, the chances are 3 out of 4 that an airline pilot will be involved in an accident during his career (900 hours per year for 30 years at 275 mph). Likewise, the chances of his being involved in a fatal accident are about 1 in 9. Looking at this, we feel that, although great strides have been made in the past, improvement is necessary and due. We feel that the past improvement was made from an extremely high rate, and that the industry should not be satisfied with the present status quo.

In any analysis of accidents, it is customary to place the blame for from 45 per cent to 50 per cent of the accidents on the pilot. We feel that while, of course, many errors of omission and commission are made by pilots, being only human, there are other underlying factors, and in the remainder of this paper an attempt is made to point out areas in which some of these factors can be eliminated.

In support of this contention, a situation that developed at the Naval Air Station, Honolulu, during the war is of interest. The main seaplane operating runways were to the northeast and east, crossing at a point approximately one thousand feet from their origins. Lighting was furnished by permanent lights on poles some six to 10 feet above water level. About two months after the commencement of operations, during a night take-off, a Navy pilot tore the bottom out of a PBM on the coral reef beyond the intersection of the two runways. The verdict was "pilot error," a finding concurred in tacitly at least by the majority of pilots flying in and out of the area. About a month later a commercial airline pilot did the same thing with a PB2Y. The plane rested on the reef most of that day and was removed just before sunset. Before sunrise there was another PB2Y on the reef within 50 yards of where the first had been.

Now, each of those accidents, by itself, could be attributed to "pilot error." However, with an accident pattern established it seemed likely that there was a contributing factor. Investigation showed that the errors of runway alignment were due to the confusion of the runway lights, on their poles at a considerable height, with the lights of Honolulu in the background. The lighting system was then modified to reduce this confusion, and it is significant that there were no more similar accidents.

Furthering this principle of outside influence as a cause of "pilot error," it would appear that the airplane design should have quite an effect. R. A. McFarland (in "Human Factors in Air Transport Design," McGraw Hill, 1946) has said:

> "The fact that accident rates vary from model to model suggests that the airplane itself may play as important a role as the human element. . . . It is commonly believed that certain air transports are generally safer to operate than others. The evaluation of such a statement is almost impossible because of the many variables involved or the lack of a common base line of comparison."

Since this statement was made, statistics have only recently become available through the CAB which make it possible to attempt such an analysis. These are presented in Figure 2, "A Comparison of the Accident Rates of Widely Used U. S. Transport Aircraft". The figures presented here apply only to scheduled flying by U. S. domestic airlines, the international figures not being available. Although there are many factors involved, it is felt that the variables of crew competence, maintenance, and operational techniques are largely eliminated through the close CAA supervision and regulation of the scheduled airlines.

In analyzing the data, it is significant in the case of the twin-engine planes to note the marked correlation between the accident rate and the accumulated mileage, and the lack of correlation between the accident rate and the period of years over which the planes flew. This leads to the conclusion that it is the original design and its development as accumulated mileage shows up weak points that determine the safety level rather than the skill of the pilots. If the latter were a major determining factor there should be some correlation of years of service with the accident rate. It is a fact, however, that piloting technique becomes soon stabilized on each type of plane and varies but little over the years and the pilots quickly become proficient in it.

In looking at the fatal accident rates, it is noteworthy that there are four types with perfect safety records (to Dec. 31, 1951). Most significant of these is the CV-240, although the accumulated mileage of the other three is sufficient to take their combined record out of the realm of pure chance. By all averages the CV-240 should have had three fatal accidents. (165 million miles [to Dec. 1951] x 1.76 fatal accidents per 100 million miles [all-planes average, 1949-50] 2.9 fatal accidents). In fact, it has had six very serious accidents but in all the survival rate has been 100 per cent. This suggests strongly that there are factors inherent in the design which account for this remarkable record. A complete examination into these factors would appear to be one of great potential industry benefit, however it is out of the scope of this paper. In passing, though, the suggestion is made that the slow spread of after-crash fire is one of the major survival reasons.

In looking at the modern four-engine planes, the uniformity of their accident rate suggests the influence of CAR 04 with its detailed performance and design requirements. It would appear that, although each plane has its individual characteristics, the overall level of safety is about the same, bounded as it is by the parameters of 04. This influence of regulation on the safety level will be covered later.

If we accept the principle of the marked effect of design on the safety record and, by inference at least, its effect on "pilot error" accidents, what are some areas that warrant attention? Two suggestions will be made.

Over the 13-year period of this study, there have been some 47 accidents due to misuse of the landing gear, either retracting it when on the ground or landing with the gear not down and locked. While these accidents are not fatal ones, they are expensive, both as to damage to equipment and as to loss of utilization. In one recent case the president of the airline has been quoted as calling it a "million dollar mistake." Obviously, the pilots don't cause these accidents on purpose, and as there is a definite pattern established by these there must be a basis for confusion of controls within the cockpit. What can be done to make it impossible for these accidents to happen? Already we have various solenoid pin arrangements whose purpose is to prevent the inadvertent retraction of the gear on the ground, but by this time they are obviously proved to be not 100 per cent effective. It is equally obvious that the landing gear warning horn does not deter people from landing with the gear neatly retracted. B. O. Howard, Vice-President of Consolidated Vultee, has proposed a system which involves "shoe strings and rubber bands," the "shoe strings" to tie component controls together so that it will be necessary to make two consecutive mistakes with different controls to cause an accident, and the "rubber bands" the bypass arrangement so that it will be possible to actuate controls out of the normal sequence if necessary, such as during a "go-around."

Basically, his system involves the interconnection of landing gear and flap levers so that it would be impossible to put down more than take-off flaps unless the gear were down

**CONVAIR** record indicates good operations are combined with plane's built-in safety factors

and also make it impossible to raise the gear when more than take-off flaps were extended. It would also be impossible to raise the flaps above the take-off position after take off unless the gear were up. This interdependence would accomplish this: 1) in order to land without the gear down, it would be necessary to forget *both* the gear and the flaps, an unlikely coincidence. In Howard's estimate, this coincidence would occur only once every 196,000,000 landings—about 150 years of domestic airline operation. 2) It would be impossible to raise the gear on the ground, thinking that it was the flaps that were being raised. 3) It would be impossible to raise the flaps immediately after breaking ground on take off instead of the gear, a very dangerous procedure with present high wing loadings.

In addition to this interconnection, he would interconnect the flaps and throttles, much as is now done with the throttles and flight control lock, to prevent a take off with flaps up. That this is an important point is attested by the author's personal experience of having made such a take off in a DC-4, in spite of an unhurried reading of the check list with both another Captain and a Flight Engineer in the cockpit and participating. Luckily, there was ample runway available, but under conditions of minimum field length with the high wind loadings now used such a take off could very easily be catastrophic.

By putting into practice some such ideas, it should be possible to eliminate 7.5 per cent of all accidents and 12.5 per cent of those attributed to "pilot error," as well as eliminate the exposure to the no-flap take-off hazard.

The second idea presented here is one in which the pilots have considerable faith, the mandatory use of reverse-pitch propellers on all airline aircraft. In the period studied there have been some 62 accidents in which the aircraft has run beyond the field boundary, either as the result of an aborted take off or, more frequently, after landing. Since the introduction of reversing propellers, no aircraft equipped with them has been involved in such an accident, with one exception. In that case, the use of reverse pitch prevented a far more serious, and probably fatal, accident. We feel that they should become a required item of equipment, much as the full-feathering propellers became a decade ago. Their use, in our estimation, would prevent 10 per cent of all accidents and 21 per cent of "pilot error" accidents.

Since the pilot is the final determinant of flight safety his help should, we feel, be actively sought in the early design stages in order to make his tasks more simple. This is occasionally being practiced, but not nearly to the extent we feel desirable. A. E. Raymond, in his excellent 39th Wilbur Wright Memorial Lecture, said, in speaking of the time of a new design's first flight:

> "Here also enters, too often for the first time, the human equation in the form of the pilot and crew. There is an increasing awareness of the fact that the experience and point of view of operating personnel should be intimately joined with that of the designer from the beginning."

And a leading manufacturer, in a personal communication to the author, wrote, in discussing the contributions made by active airline pilots to the success of the design:

> "The question of why there was success here and not elsewhere seems to be answered by the timing factor. This program was set up at a very early date in the development, thus allowing enough time to thoroughly discuss differences of opinion and reduce them to an objective common denominator."

We wish the thoughts expressed above were more widely practiced within the industry.

In passing, it might be well to note that the Air Line Pilots Association is carrying on an active campaign of familiarization with the problems of design and operation of turbine-powered transports in anticipation of their early commercial application, and we would welcome the opportunity to contribute to their safe and efficient development.

Given an initially sound design, the next and very important step in making it a safe plane to fly is the "debugging" of it under actual operations. Contrary to popular opinion this process does not end with the first few years in service but extends throughout the total operating life. Figure 3, "Accident Rate as a Function of Cumulative Miles Flown," shows this clearly. Though the initial 4 or 5 hundred million miles are probably the most important, the DC-3's long history shows a continuous gradual improvement beyond that point. This initial rapid improvement is also clearly shown by the DC-4 and 6 curves, evidence of the excellent joint efforts of the manufacturer and operators. If their future development parallels that of their predecessor, and if other current transport types are improved at the same high rate as has been shown for these types, we indeed have promise of a marked improvement in the over all accident rate.

Incidentally, in the preparation of this figure it was not meant to slight other types. The aircraft plotted were chosen because their accumulated mileage in domestic scheduled service was sufficiently large to plot a reasonably smooth curve.

Also pointedly showing the effects of improvements while in service is Figure 4, "Accidents Caused by In-Flight Fires." The importance of this plot may be shown by the fact that accidents from this cause are twice as apt to be fatal as those from all causes.

In this figure there are three periods of note. First is the tremendous improvement in the period from 1938 to 44. The abrupt drop to the almost perfect record of 1940 through 44 can be attributed to two factors, the mandatory introduction of feathering propellers and the extremely reliable Wright and Pratt and Whitney engines in common use during that period. Of these we believe the ability to stop rotation of a failed or failing engine was undoubtedly the dominant factor.

The second interesting period is the marked jump in the curve for 1945 through 48. This was the time when the modern four-engine transports, with extremely high-power engines, were first put into service. The record speaks for itself in showing that the in-flight fire situation was not what it should have been when these planes were in their early development stages.

The final period is the abrupt drop off from the peak year, 1948, showing that the previously hazardous conditions have been brought under reasonable control, through the close cooperation of the manufacturers, airlines, and CAA.

(*Continued on page 42*)

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# Airline Pilots...Safety

(*Continued from page 41*)

There have been, however, some instances of slow or ineffective corrective efforts which have upset the pilots and often tend to becloud the really excellent general efforts. Perhaps the most spectacular one is the high incidence of uncontrollable engine fires in a widely used modern transport. In 1945, in the military prototype, the first such incident occurred, resulting in a fortunately successful forced landing. In 1946 a similar incident occurred in commercial operation. The cause of these initial fires was determined and corrected, but apparently the extinguishing problem was not solved for we find in 1947 and again in 1950 fatal accidents caused by engine fires which the flight crews were unable to control. Again, last year, there was another such incident, but happily, as in the initial ones, a successful forced landing was made. In this unfortunate and lengthy history there have been several different causes for the initial fires which have been subsequently corrected in each case, but the underlying basic accident cause, uncontrollability, was dealt with inadequately with tragic results.

Another problem which undermined the confidence of pilots who knew the details dealt with propellers. In this instance, after several vivid but fortunately non-fatal demonstrations of what happens when a blade snaps, a program was set up to replace the defective type with improved ones over a considerable period of months, a deadline of hours being placed on the service life of the former. Following another incident of in-flight blade failure, this program was accelerated and all of the defective type were out of service in approximately two weeks, as contrasted with the prolonged initial replacement program. The slower program, it developed, had been predicated on the deadline of hours, mentioned previously, which had been based mainly on financial considerations rather than on, we think, a conservative technical evaluation of potential seriousness of the already demonstrated hazard.

Leaving the design and development aspect of operations, we can logically progress to the actual flying of the equipment by the pilots. Occassionally the statement is heard that the pilots have not progressed with the industry. In this connection it is pertinent to note the increased complexity of the airline cockpits. Over the years, the instruments, controls, and gadgets have increased from 289 for the DC-3, to approximately 400 for the DC-4, 522 for the CV-240, some 600 to 700 for the DC-6, to about 1,000 for the B-377. Ten years ago how many people had ever heard of $V_1$, $V_2$, ADI, TBS, TAI, RMI, VAR, VOR, ILS, Mach limitation, etc? It is granted that the gadgets all have their purpose and have contributed to the increased level of safety, but who can say that they have really made the pilot's job easier? In fact they have greatly increased the chances for confusion and mistakes, and the fact that the percentage of accidents attributed to "pilot error" has not increased with the increased complexity, but has remained relatively constant, is, we feel, proof of the adaptability and professional progress of the pilot group.

Simultaneously with this increased instrumentation and gadgetry has come the lowering of minimums and the raising of approach and stalling speeds. Ten years ago the common weather minimum was 500 feet and 1 mile and the common approach speed was 90 mph. Today at some fields we find minimums lowered to 200 feet and ½ mile while the approach speed has risen to 150 mph. True, the alignment problem is more accurately solved by ILS but, nevertheless, the time available for the pilot to orient himself properly after becoming "visual" has decreased tremendously from 40 seconds to 12 seconds. In a talk at the Wings Club in New York, R. B. Roe, chief test pilot for Sperry Gyroscope Corp., commented on records which showed that under actual 200 feet-½-mile conditions one of every three approaches is missed. Roe said:

> "This record is no reflection on the professional ability of the airline pilot for he is doing the best possible job with the tools at hand. It does, however, demonstrate graphically the inadequacy of his tools."

We feel that this demonstrates also that minimums of 200-½ are, at this time, not realistic when the human equation is taken into account with the instrumentation and speeds presently provided. In order to correct this, even at the expense of increased cockpit complexity, the addition of an instrument such as the Zero Reader or perhaps automatic approach may be the answer. In this case, even though another gadget is added, the actual task would be simplified and the safety level raised.

Even as cockpits have become more complicated, so have the airway facilities. The number of ranges, ADF beacons, marker beacons, ILS, etc., have nearly saturated many areas. As more accurate fixes and approach systems have been evolved, the increased accuracy has been used to cut approach times and increase the number of aircraft movements, while holding the same level of safety. This, instead of easing the pilot's job, has, in most cases, complicated it further. In a recent fatal accident there is a possibility that the multiplicity of facilities and choice of approach methods may have confused the pilot to the point that the ADF was tuned to the wrong station for the chosen approach method with the result a mass of tangled wreckage on a hillside.

The hitting mountain problem has been with us for many years and the often-noted tendency for the fatal lack of terrain clearance to be very small gives rise to speculation as to the number of cases where the safe margin was equally slight. In other words, no one really knows how great is the exposure rate to this type of occurrence. Recently an incident happened which shows how easy it is to have a false sense of orientation.

The flight was a long distance one over mountainous European terrain. The forecast wind was badly in error, the actual wind being in the order of a 100-knot (115 mph) headwind instead of 20 knots (23 mph), so the flight was uncertain of its ETA. Both ADF's were tuned and, although there was considerable snow static, identified on the destination station and the ILS was likewise used. Presently both ADF's reversed, indicating an overhead, and almost simultaneously the ILS needle changed quadrants, confirming the position. The pilot requested and was granted letdown clearance from his 14,000-foot approach altitude. However, for some reason, before descending he switched frequency and requested a VHF DF fix from the Air Force net in the area. This fix showed his true position to be 75 miles from the station, over mountainous terrain. If he had let down, on what was apparently sufficient proof of his position, there is little doubt that he would have become a statistic in the "pilot error" computations.

The point to be made here is that, unlike a mountain which always knows where it is, a pilot may at times mistake his position or else, as in the above case, receive erroneous indications of his position and, acting on his best judgment, let down into a hill or mountainside. This has been amply demonstrated over the years, but little has been done to provide a positive answer to the problem, except for the abortive effort several years ago by the CAB to make a terrain warning device mandatory. Perhaps the order was premature, due to the unreliability of the popular device, but is appeared to the pilots that more effort went into proving that the device was unreliable than in improving it to a practical and useful point. One airline, however, TWA, did work on its terrain warning indicator and now has installed it on a voluntary basis. The author has talked to many TWA pilots concerning this and finds an almost unanimous approval of it.

Perhaps cockpit radar is a more sure and versatile answer, but a practical terrain warning device would eliminate 20 per cent of the fatalities, and would reduce "pilot error" accidents by 6.5 per cent. We feel that this is an important area to which industry attention and action should be focused.

In planning design and operations, the average level of competence of the pilot group should be carefully kept in mind. Too often, it seems, operations are planned which require an exceptionally high level of skill and are not realistic in that, while average skill is adequate under normal conditions, trouble is invited under abnormal conditions of airplane malfunction coupled with unfavorable weather. That this is true is easily understood because the executives who do the planning are usually superior in intelligence and experience and have better access to information and plan operations through their own eyes and capabilities. It is, however, a condition which should be guarded against.

An integral part of operations and safety is training. It is obvious that constant training and checking in both old and new procedures is one of the cornerstones of flight safety. However, there is often a tendency to use intensive training to make up for design and operating deficiencies. In regard to this R. A. McFarland (in "Human Factors in Air Transport Design") says:

> "The most promising solution lies in the simplification of the tasks of the air crew rather than in an attempt to improve the quality of the personnel, which is already of a high order in the civil air lines. The relationship between the difficulty of tasks and human performance has been simply expressed by the analogy of a number of people given the assignment of walking a two-foot wide plank on the ground without falling off. The percentage of human error would be negligible. If the plank were reduced to a two-inch width and raised a considerable distance off the ground, the number of failures would increase rapidly. Extending the analogy to the simplification of the cockpit, it would be easier to facilitate the task by increasing the

width and lowering the height of the plank than to select a group with sufficient skill to be able to walk on the narrower plank higher above the ground."

Frankly, the pilot group feels we are walking a narrow plank.

An interesting training area that has been little explored to date is the use of electronic trainers to determine whether present procedures are straining the flight crew's ability to the breaking point. PAA has made some use of its Dehmel trainer in this light, changing procedures that have resulted in "crashes" of the trainer, but to date no effort has been made to put a coordinated and well-planned research program along this line into effect. The results could prove very useful.

The final facet in the air-safety picture is regulation, having implications in all the previous fields, design, operations, and training. Although there is often the cry of "over regulation," clear-thinking people will, the author believes, admit that it is, at its worst, a necessary evil. The best example of the effects of under regulation is the state of safety among the nonscheduled airlines. Some of these operators have excellent records but there are many who cut the corners of sound practice and the over-all record shows the results.

There is a basic conflict in air transportation between economics and safety. It has often been said that the only 100 per cent safe aircraft is one which never leaves the ground. However, the economics of such would be nil and the problem is where to adjust the meeting point of the conflicting interests. Here is where, oftentimes, it is necessary to have the CAA/CAB as a sort of umpire, balancing economics, safety and public interest one against the other.

In discussing Figure 2, the apparent influence of CAR 04 on the safety record of modern four-engine planes were pointed out. It appears that these regulations have put a minimum floor under the characteristics of these designs while at the same time allowing enough leeway for sound economics. However, this evenness of the safety record suggests a corollary: the planes were tailored to exactly meet the regulatory requirements, in at least several respects. This, though understandable in view of the intense competition among manufacturers, is not exactly desirable for it tends to stifle safety progress. However, competition being the American way of doing things, the situation will probably remain much the same in the future which points to the constant necessity for the CAB to make the requirements ever higher as the state of the art permits.

Much the same situation exists on the airlines in regard to their operating rules, CAR 41 and 61. Here, however, there is discernible a tendency on the part of some lines to conduct their operations on a safety plane above that required by the government agencies. This sometimes puts them at a competitive disadvantage in spite of their higher safety record, since it is as much the other fellow's record as one's own that determines the desire of the public for air transportation. Therefore, the CAB should always be alert to incorporate in the regulations, as applicable to all, those advances of any carrier which raise the level of flight safety.

As inferred above, the regulations should be fluid as well as realistic. Where weak spots show up, the regulations should be modified to cope with them. A recent case in point was the amendment of the stalling regulations of CAR 04. In this case a regulation that had served well for several years not only became a barrier to new development but, in the case of one airplane at least, its literal application gave rise to a more dangerous condition than the one it was designed to prevent. The regulation, with the support of manufacturers, airlines and pilots, has now been modified and the condition referred to above is being rectified.

In providing this fluidity, the annual Airworthiness Review of the CAB Safety Bureau is extremely important. Although some dissenting opinion on this subject has been heard from industry quarters, the pilots feel that this is the right way to go about the problem. Incidentally, at the most recent meeting in August, 1951, the pilots were very pleased with the reception that was accorded their points of view and we would like to take the opportunity to assure the industry that this was not a flash-in-the-pan effort. C. N. Sayen, president of the Air Line Pilots Assn., said in a speech to the Aviation Writers Assn. in Washington, in 1951:

> "The pilot's welfare is tied to the safety and dependability of the operation of his aircraft. A large part of the activity of ALPA must, therefore, be devoted to doing all possible for an increased standard of air safety. If there is a malfunction of any of the complex component parts which make up the modern aircraft, the airline pilot is the first one who will be cognizant of such defects and who may suffer from their inadequacy or malfunctioning. He must, then, be in a position to make his voice heard on such matters and he must be a powerful and independent spokesman in the field of air safety."

In this paper the author has tried to show the great importance of airline safety to the sound and rapid development of this still growing industry and to point out some areas where improvement can be readily made.

Airline safety is influenced by many factors, but it appears that the human limitation factor is the one offering the best chance for improvement of the presently stabilized record, not by more severe selection or training but rather by designing operations and equipment to more adequately conform with human ability.

By implementing the three suggestions: mandatory reverse pitch, "shoe strings and rubber bands," and a terrain warning device, is appears likely that fatalities could be cut 25 per cent, accidents by 20 per cent, and "pilot error" accidents by 40 per cent. In these cases, human limitations would remain the same, but the tools would be designed to overcome them.

The pilot's success in flying the plane is, after all, the ultimate test of all safety efforts. As C. N. Sayen has said, the pilot is the first to know when things go wrong and he can often in advance sense the chance of things going wrong.

To quote the Colonial Airlines slogan, "Safety is no accident," it is rather the result of the proper integration of sound design with good operations. We feel that, in the past, in accomplishing this integration more attention has been given to economic factors than to human limitations.

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**FLORIDA WING** employs horses as well as Swamp Buggies and planes. Here Lt. Col W. Phillips, CAP Operations Training Director, briefs a unit on horseback on a search mission in Glades

# Neighborhood Airforce

(*Continued from page 19*)

pensed for the gas and oil they use unless they are called on an official mission by the U. S. Air Force, such as search for a downed plane of the armed services or a commercial airliner. These calls constitute barely 10 per cent of their missions.

Born of Civil Defense a week before Pearl Harbor, the CAP flew more than 24 million miles in little single-engine put-puts. They patrolled coast lines and flew dangerously out to sea as submarine spotters when the Navy and the Army Air Force had neither the planes nor the pilots for such work. They flew sentry along the Mexican border on the lookout for spies and saboteurs; they ferried bombers from aircraft companies to airfields, and they flew across country with secret dispatches. In that duty 51 CAP members, including two women, gave their lives.

Today the CAP is more active than ever, and far better organized than during the war. And it has gained official recognition! CAP now is officially designated as the Civilian Auxiliary of the U. S. Air Force, with authorization to wear Air Force uniforms with CAP insignia.

At the top of CAP is a national headquarters, staffed entirely by regular Air Force personnel under the command of Maj. Gen. Lucas V. Beau. It provides each of the 52 wings—the 48 states, the District of Columbia and the territories of Alaska, Hawaii and Puerto Rico—with a regular Air Force officer, two noncommissioned officers for administration and aircraft maintenance, and a civilian stenographer. But CAP remains under civilian command. Neither General Beau nor any of the 52 liaison officers has any power of command over CAP personnel.

Most authorities regard the CAP as their best bet when a plane has crashed or persons are reported lost in any of the country's vast wooded areas. And in their slow lightplanes CAP pilots can skim at treetop level and scan the ground far better than those in higher-flying, faster aircraft.

CAP's most striking results come when it is called out on emergency duty. The Texas Wing alone can muster 500 planes immediately. While it wasn't called upon for that many planes, it performed outstanding service after the explosion of a nitrate-laden French freighter in the harbor at Texas City, Texas, on April 16, 1947, which killed 512 persons and destroyed $50,000,000 worth of property.

A group of seven CAP members, the first rescue squad on the scene, went into the disaster zone before the second of the series of explosions that rocked the city all day. CAP members set up stations and directed all the rescue work as other volunteers finally joined them. In the meantime CAP pilots flew blood plasma, doctors, nurses and medicine to the scene. Within five hours after the first blast, the CAP had flown in 23 undertakers from five states; scores of wrecker crews, gasoline and water for ambulances and trucks that were needed for removal of the dead and injured.

Lt. Col. Frank S. McClendon, a Dallas insurance man, was the Wing's executive officer and directed the rescue work.

"We didn't sleep for three days," he told me. "CAP men went into the disaster area when no one else dared and saved lives dragging badly injured persons out from flaming wreckage. The odor from the chemicals soaked into our clothes to such an extent that we all had to burn our uniforms."

It is exactly this kind of work that the CAP is prepared for if our worst fears are realized and the United States is ever under bombing attack.

As soon as the seriousness of last summer's floods in the Missouri River valley was apparent, Gov. Edward F. Arn of Kansas called for help from CAP wing headquarters in Wichita. By daylight the next morning CAP had more than 100 planes in the air, patrolling the flooded area for marooned persons and flying in doctors, nurses and emergency rations. The Wichita squadron put in 20,000 man-hours during the emergency. Senior members and cadets worked around the clock on dikes, filling in sandbags.

Col. Wayne Foster, Wichita salesman, was in charge of radio personnel. He stationed cadets with walkie-talkies at strategic points where they could direct planes and motor boats. Pat Allen, a 15-year-old cadet, took Foster's orders so literally that he was soon standing in water up to his armpits. When Sgt. Ted Putman of the Air Force saw him and asked him why he didn't move to a dry mound less than 100 feet away, the lad replied, "Sergeant, Colonel Foster put me here and told me to stay."

In Topeka all commercial radio stations were off the air. But necessary communication for rescue work was provided by CAP's system until CAP pilot Howard Culbertson, a former squadron commander at Sterling, flew to Omaha and returned in five hours with a 400-pound piece of equipment that permitted one station to get back on the air.

The 57 planes assembled at Topeka were dropping rations and clothing to marooned families and picking up stranded persons with pontoon-equipped planes, dropping hay to cattle and horses, and doing any other jobs that came their way. During the emergency these planes flew 224 missions.

At Grandview Airport, CAP seniors, and cadets, members of the Kansas City Squadron, stood guard-duty for 30 hours, keeping people from rushing onto the field and into landing airplanes. Twenty-three-year-old Miss Jo Stafford, of the Kansas City Traffic Bureau, was one of the CAP members who guarded the airport. With the temperature hitting 100, no drinking water available, the sweltering sun burned Miss Stafford so badly she had to wear bandages for four days.

At the first news of weakening levees at St. Louis, the CAP squadron commander started a motor caravan toward West Alton at 2 a.m. Forty-five minutes later it reached the Wagner Levee; and for the rest of the night CAP members worked at sandbagging in darkness, sometimes standing knee deep in mud. Women filled the bags and the men carried them to the levee; but at 7 a.m. the rising waters went rushing through a 15-foot break in the bank and all the work of the night went with it. Three more levees had to be sandbagged before the flood danger had passed.

Twenty-nine-year-old 2nd Lieut. Victor Hewitt, Operations Officer of St. Louis Squadron 2, lost his life during a flood mission. He rented a plane so that he could fly over the levees and report weak spots. The owner of the plane went along as pilot.

On the take-off the plane struck a high-tension line, crashed and burned. The pilot survived, but Lieut. Hewitt was killed. His wife buried him in his CAP uniform and then she joined the squadron to take his place.

Last fall when a half-million-dollar gas explosion struck Brighton, N. Y., CAP radio units and rescue workers were on the scene within 25 minutes after the first blast. The explosions demolished 15 homes. CAP members assisted in the search for the dead and injured, and checked lists of patients at hospitals. In the meantime a central communications system with five transmitters and two operators was set up in a CAP bus, and 14 mobile radio units were put into action.

Minutes are often important in air search and rescue. One night last June, Col. Theo Enos, Utah Wing Commander, was awakened in his Salt Lake City home by the telephone. It was the Salt Lake City airport calling. A Taylorcraft with 22-year-old Darrel Walkemeyer, pilot, and his fiancee, Jodie Archer, was three and a half hours overdue at Rock Springs, Wyoming. Could the CAP start a search?

At 6 a.m. 20 CAP planes were ready to take off. Capt. Curtiss Ellsworth, a building contractor, was the first pilot to leave. He headed for City Creek Canyon, rugged, heavy-sloped country, full of mist and fog, where any pilot unfamiliar with the air currents might be caught in a down draft and crash. But Capt. Ellsworth was an oldtimer at contour flying, and 10 minutes after his take-off he spotted the wrecked plane standing on its nose in dense shrubbery about 8,000 feet up on the Wasatch Range. Beside the wreck stood Walkemeyer, waving frantically.

Ellsworth circled, dropped blankets and rations and radioed Operations Base. Members of Utah's CAP radio-equipped Jeep Patrol, with an ambulance and policemen, made up a ground-search team that Ellsworth guided through thick underbrush up rocky clifts to the crash. The last five miles the rescuers had to go on foot. Jodie Archer was unconscious. She lived, but the doctors at the hospital where she was taken said if her rescue had been delayed another hour she could not have survived.

The Rockies are a veritable graveyard of crashed planes, and it is almost impossible to tell from the air whether a wreck is old or new. Arizona Wing Commander Dines Nelson now sends cadet teams to every old wreck spotted by his pilots, and they paint huge yellow crosses on the wreckage.

During the West's big snow of 1949, CAP planes dropped food, clothing, fuel, mail and medical supplies to snowbound people, including many Indians marooned on their reservations. Colorado and Utah Wings dropped dogs by parachute to sheepherders whose dogs had been killed by wolves. Some CAP pilots made as many as 30 trips a day. Senior members and cadets cleared the snow from roads to airports and from landing fields, often working in snow waist deep.

Many lives were saved by CAP members during that winter, but the Nebraska wing lost two of its members, Lieut. John Huff and William O'Brien. They were delivering food and mail to a snowbound farmer when their plane hit an aluminum wire invisible against the snow.

In Maine, CAP snowmobiles have time and time again been the difference between success and failure of rescue missions. The snowmobile, which is a sled about 15 feet long with an airplane propeller, is capable of doing as much as 100 mph but its principal value is in getting over deep snow. Fred Salem, CAP member from Millenocket, who has invented seven models of these snowmobiles, made a fast and successful rescue last winter when an auto driven by two fishermen across Millenocket Lake caught fire in 22-below-zero weather. The men got ashore and telephoned for help from a hunting lodge. A truck with two men was sent to their aid, but the heavy machine went through the ice. Game Warden Al Cummings was notified of their plight and called Salem. Within an hour Salem and his snowmobile were there, and pulled the car and the truck from the lake. "It would have taken me a day and a half to reach the scene on snow shoes," Warden Cummings said.

Down in the Florida Everglades the CAP uses swamp buggies. These are boats with airplane propellers that can skim through shallow water at 50 mph. The CAP members who use these have to be familiar with this region that is infested with wildcats, alligators and snakes. Last winter a frog hunter who had wrecked his boat when he ran into a submerged island was rescued by a CAP member in a swamp buggy after he had been lying helpless in this dangerous swamp jungle for 36 hours. A CAP plane spotted the hunter, then guided the swamp buggy to the scene.

The Rhode Island Wing flew nine mercy missions last winter, carrying stricken persons from Block Island to the mainland for emergency operations or medical attendance. There is no hospital on the island and its 2500 residents are often marooned in the winter when the ferry is unable to operate. The lone doctor calls upon the CAP when an emergency arises, and it hasn't failed him yet.

The CAP is called upon for many odd missions. One winter large bands of coyotes in Texas had killed and eaten more than 1400 head of cattle. When all other efforts to catch the marauders failed, Gov. Coke Stevenson appealed to Col. D. Harold Byrd, then commander of the Texas CAP Wing. Col. Byrd took up a flight, with an observer in each plane armed with shotguns. One had a machine gun. Strapped in, but leaning out the right door which had been taken off for this purpose, the observer shot the coyotes as a low-flying spotter plane chased them out of their lairs.

In Florida they have helped save orange crops when unexpected freezes endangered the fruit, by flying low over the groves to stir up the low-flying warm air by the blast from their propellers.

In California, one year, the wild ducks and geese arrived three weeks early in the vast rice fields of the San Joaquin Valley. The crop was just heading and the great flocks were making a festival of the tender stalks. Capt. Ed Meyers summoned his Sacramento squadron and, skimming low over the fields, drove the wild fowl to game refuges where feed had been deposited.

In Oklahoma, CAP members are called out to de-ice high-tension lines to prevent them from breaking. Flying close, their propellers blast the ice from the sagging wires, Col. W. H. Chockey, Wing Commander, explained.

Nothing, indeed, seems to stump the Civil Air Patrol.

At every airport in America, you'll see young men standing outside the fences, watching the planes come and go; watching the busy hum of the activity of servicing and repair. Are you one who only watches when you could be an important part of these activities?

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# d. c. Generators

(*Continued from page 27*)

armature coils, is thus prevented and commutation is improved at all loads.

There are several important factors to be considered in selecting a generator for your aircraft. They are:

1. Desired capacity
2. Drive coupling and mounting flange detail
3. Speed requirements
4. Direction of rotation
5. Cooling system

1. *Capacity:* As mentioned earlier, the rated output of one generator should equal the minimum electrical load requirements of the aircraft.

2. *Drive Coupling and Mounting Flange Detail:* This information can be obtained from the engine manual or by a visual inspection of the generator mounting pad. To determine the adaptability of the generator to a particular installation, it is necessary to consider the shape of the mounting pad, number of studs, diameter of studs, pilot diameter, and the bolt circle diameter. The drive coupling may be difficult to ascertain on visual inspection but the most popular splines in use on present-day aircraft are the six-tooth and the 16-tooth splines.

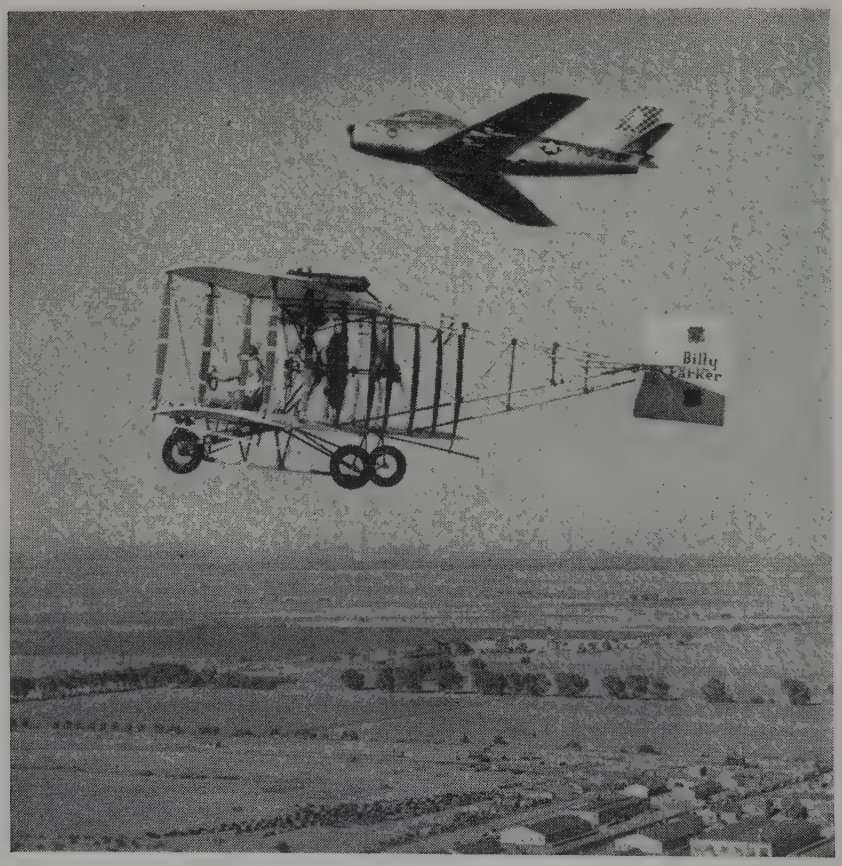
3. *Speed Requirements:* (Minimum and Maximum) This is one of the most important specifications to be considered in the selection of your generator. Generator drive pads may be of high or low gear ratio. A generator must be selected which will produce its rated output during periods of minimum engine speed. These periods will most likely occur during taxiing and warmup. The speed requirements are particularly important if much night operation is anticipated.

High-speed generators mounted on low-speed accessory drives will result in "no generators" at all during ground operation. Low-speed generators mounted on a high-speed drive will produce "overspeed" in the generator and result in serious damage to the generator and the electrical system.

A 1.5-to-1 generator drive gear ratio will produce a generator shaft speed of 1500 rpm with an engine speed of 1,000 rpm but very few present-day generators will produce their rated capacity at this low speed. The 3-to-1 generator drive gear ratio is much more desirable for the 200-ampere medium-speed generators available for present-day use (such as the Eclipse-Pioneer type 1193 generator). This unit, which specifies a minimum rated speed of 2800 rpm for 15-volt operation and 3,350 rpm for 30-volt operation will guarantee full system voltage during ground operation and under all flight conditions.

3. *Rotation:* Refer to generator name plate for direction of generator rotation and to the engine manual for direction of generator drive coupling rotation.

4. *Cooling Requirements:* Visual inspection of the generator and engine baffle plates will indicate whether or not cooling ducts can easily be run to the generator. It is important to avoid any installation where oil drainage might be brought back into the generator air duct. Such oil can result in a glazed commutator, eventually leading to an insulating film being built up between the commutator and the brush. Modern generators, designed to be both compact and efficient, require air-blasting cooling. This air should be taken from the front of the engine. Manufacturers specify the cubic feet per minute air flow and the minimum pressure required for maximum efficiency. It is wise to be sure the installation in your aircraft meets these requirements.




**40 YEARS OF PROGRESS**—What has happened to the airplane in four decades is graphically revealed in this photo of F-86 *Sabre* flying by a 1912 pusher plane. The aged pusher shown here, which was built and flown by Billy Parker, cruises at 60 mph, weighs 1,075 pounds; *Sabre* weighs 13,715 pounds

### *Generator Paralleling*

There are two basic systems of paralleling, commonly referred to as the Army system and the Navy system.

In the Army system external resistors placed in the negative lead to ground, provide a 0.5-volt drop at maximum rated output. This voltage drop is used as the paralleling signal and varies in proportion to the current produced by the generator. The Army system has one weakness—with the addition of the external resistance, to obtain the 0.5-volt drop, a loss is produced equal to approximately one and three quarters per cent of the rated generator output at full load. (*See Figure I for wiring diagram.*)

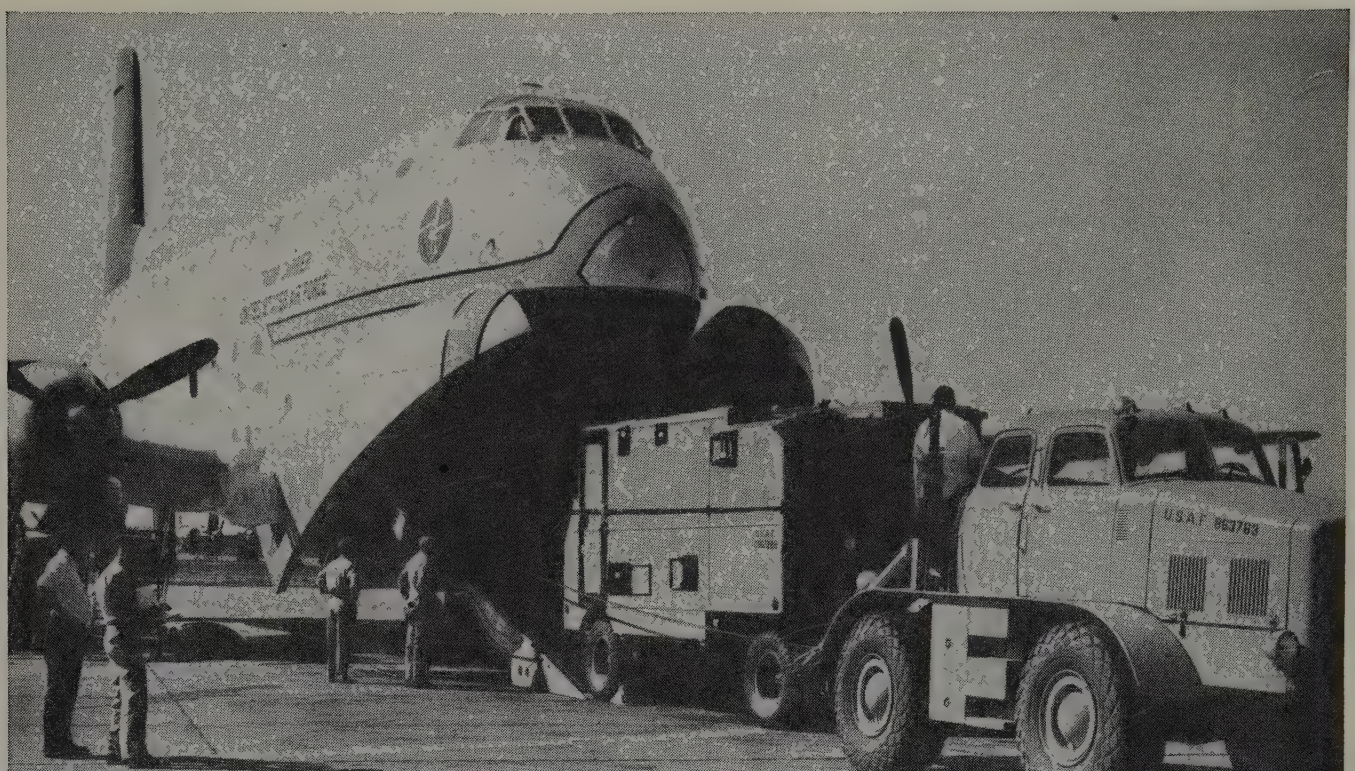
The Navy system of paralleling utilizes the interpole and compensating windings to obtain the paralleling signal for the system. The voltage drop in the interpole and compensating windings of the generator is between one and two volts. In comparison to the Army system, this design provides a stronger paralleling signal, thus increasing the efficiency of the paralleling circuit, which allows a finer division of applied loads. (*See Figure II for wiring diagram.*)

There is a potentiometer connected across the interpole and compensating windings to compensate for unequal voltage drops in the series field circuit. The equalizer circuit is connected to the movable arm of the potentiometer.

In more recent systems, where all the generators concerned are of the same make and type, it has been found that better paralleling and a simpler system may be had by omitting the potentiometers. The slight differences in the interpole and compensating winding drops, from unit to unit, prove to be a negligible factor in load division. This is true because a much stronger equalizer current is obtained when the equalizer is connected directly to the interpole and compensating windings of the generator.

The Air Force is attempting a still greater improvement. A tap is provided on the interpole and compensating windings of all generators which will provide a standard drop of two volts at full load. This will allow paralleling of all makes and types of generators in any desired arrangement.

Realizing how important generation of electrical energy is to the functioning of the aircraft, every unit contained in present-day electrical systems will be discussed in subsequent articles. With the increased application of electrical and electronic devices in present-day aircraft, it is felt that articles such as these will be a valuable guide to both mechanics and pilots in their everyday work. mechanics and pilots in their work.



**MOBILE GCA UNIT** is loaded aboard a C-124 *Globemaster* at Haneda AFB, Japan for airlifting to Korea by the AF Combat Cargo Command

# Lesson in Logistics

(*Continued from page 17*)

Formerly, strategic airlift was a one-way street. Today, in bringing back the military ill and wounded to the U. S., MATS utilizes what would otherwise be empty space after having delivered critical cargo and high-priority personnel to the Pacific.

A dramatic demonstration of this by-product occurred early in August when a Douglas C-74 *Globemaster* carried 74 patients from Honolulu to Travis AFB, Calif. Boeing C-97A *Stratofreighters* carry an average load of 65 patients. Douglas C-54's normally airlift 28 patients.

Since the start of the Korean action, nearly 38,000 combat casualties and military ill and wounded have been brought back to the U. S. from the Far East.

The Pacific Airlift is the latest achievement of MATS, a major Air Force Command formed in June 1948 by the consolidation of the Air Transport Command (ATC) and the Naval Air Transport Service (NATS). This merger was made in accordance with the directive of the Secretary of Defense and Air Force chief of staff.

During the war, these two transport services supported war operations in the various theaters by transporting personnel and cargo and by the ferrying of aircraft to all parts of the world.

Today, integrated and unified, the USAF-Navy air arm that is MATS still furnishes strategic air transport for the entire Department of Defense. But MATS duties differ distinctly from its war-time operations. Its responsibilities have been vastly augmented.

MATS today includes the Airways and Air Communications Service, Air Weather Service, the Air Rescue Service, Flight Service, and Air Resupply and Communications Service. These organizations are not merely MATS appendages but integral parts of an over-all organization designed to furnish strategic airlift support for the entire Department of Defense.

At this point, perhaps, there arises an important question in the minds of some military men: why are these services combined with MATS?

Changing concepts in modern military strategy, tactics and logistics render the answer a simple one.

Each of these technical support services is limited in no wise by geographical considerations. The global character of AACS, AWS and ARCS is similar to that of long-range military strategy.

Requirements for centralized control, unified training and procedures, standardization wherever applicable, and organization on an integrated system basically are the same.

AACS, with its worldwide radio and communications facilities; AWS which supplies information and forecasts on a global basis; ARCS which disseminates psychological warfare material as directed by theater commanders and carries out the resupply of military units, are joined with MATS because of the closely associated tasks which they must perform as a team.

ARS likewise functions on a global basis. Flight service, concerned with monitoring aircraft within the United States, is closely tied in with AACS and AWS.

Since most of these technical support services are closely interrelated and interdependent, maximum efficiency can best be secured only by placing them under the control of a strong, central, single command.

Strategic air-transport support, or logistics in military parlance, assumes increased importance when the Korean action is brought into focus.

Until recent years, interest in logistics was limited to a small select circle of far-sighted military realists. Strategy appealed to the intellect; tactics to the emotions. The allegedly dull drudgery of providing the right things for the right persons in the right places *at the right time* appealed neither to the intellect nor to the emotions.

But in recent years military men have changed their concept of strategic air-transport support. They learned during World War II in the CBI operations that moving whole armies over treacherous mountains spelled out the difference between victory and defeat.

Later, during the world-acclaimed Berlin Airlift, this U. S. air arm and its British counterpart sharply focused the fact that strategic air transport can be forged into a weapon for peace.

The Pacific Airlift has firmly established that all global strategy must take into consideration the capabilities of strategic air-transport support. Tacticians, too, give it prime evaluation. Air logistics in Korea has saved lives, which in turn makes for better morale—always a decided advantage to the strategist, the tactician to the field commander, and finally to the decisive defeat of the enemy.

In addition, the Pacific Airlift posed the problem of bridging space and conquering time. Within the limitations of aircraft and personnel, we solved those two problems.

Meanwhile, MATS, together with other U. S. air arms, continues its day-by-day strategic air-transport support to Korea with sufficient men and material to meet military requirements of critical cargoes and high-priority personnel on that land mass some 7,000 miles from our shores.

# Remote-Indicating Compass

(*Continued from page 25*)

mounted compasses, as the name implies are mounted in a cutout on a panel and only a small portion of the compass card is visible. Top-reading compasses are mounted on a horizontal surface. A pointer is attached to the float, and provides indication to a fully visible compass card.

The tendency of the magnetic compass is to dip down because of the downward pull of the earth's magnetic field, but this is not noticed in straight-and-level flight due to the design features of compass-card mounting.

When the airplane is banked, the compass card also banks as a result of the centrifugal force acting upon it. While in this banked attitude, the vertical component of the earth's magnetic field causes the north-seeking ends of the compass to dip to the low side of the turn, giving the pilot an erroneous turn indication. This error is most apparent on headings of north and south. When making a turn from a heading of north, the compass briefly gives an indication of a turn in the opposite direction, and when making a turn from a heading of south it gives an indication of a turn in the proper direction but at a more rapid rate than is actually being made. Errors given here occur in northern latitudes, and are exactly reversed in the southern hemisphere.

The acceleration error of the magnetic compass is also due to the action of the vertical component of the earth's magnetic field. The compass is usually mounted in such a way that it acts as a pendulum and is tilted during changes of speed. Such momentary deflection of the card from the horizontal results in an error which is most apparent on headings of east and west. When accelerating on either of these headings, the error is an indication of a turn to the north, and when decelerating the error is an indication of a turn to the south.

In rough air or under inept pilot technique, the compass card tends to swing erratically, thus creating an error in observation of the indicated heading and making it extremely difficult to hold a given course.

Deviation, the difference between the indications of a compass in a particular aircraft and the indications of an unaffected compass at the same point on the earth's surface, is an important factor in using the magnetic compass. By reason of being located at the point of use, the panel-mounted instrument of common use is necessarily located in the flight compartment of the airplane. The many components having iron or steel parts which are mounted adjacent to this area may have an effect upon the reading of the magnetic compass. Also, the many items of electrical equipment such as lights, motors, and instruments, along with the stray magnetic fields created by their associated wiring, often create a pronounced deviation error in the magnetic-compass indication.

Adjustment of the compensating magnets may reduce the deviation error, but compromise results must often be accepted in this procedure. Also, deviation may change for each piece of electrical equipment placed in operation.

In brief, then, the inherent operational difficulties of the magnetic compass can be

| Trouble | Probable Cause | Remedy |
|---|---|---|
| Instrument does not start. (Caution: If gyro does not start within 20 seconds, turn off power and investigate. If *single*-phase power is supplied to gyro, it will burn out.) | Failure of power supply. | Check power supply at the Gyrosyn Compass Indicator. Use Sperry Power Supply Checker T-100671, or equivalent. The a-c voltage should read 26 ± 1 volts and the frequency 400 ± 40 cycles. |
| | Connections from instrument to power supply incorrect. | Check cables, plugs and receptacles. |
| | Faulty Gyrosyn Compass Indicator. | Check continuity of 3-phase circuits in gyro at receptacle in the rear of the Indicator. If faulty, replace instrument. |
| Annunciator shows dot, cross, or black continuously upon 360° rotation of pointer or dial. | Proper power not supplied to instrument. | If gyro has started, it is only necessary to check d-c supply. |
| | Short or open in excitation circuit to Flux Valve. | Check continuity with Flux Valve Continuity Checker T-100870 at receptacle on indicator end of cable.<br>(Caution: Do not use a d-c ohmmeter across any coils of the Flux Valve.)<br>Check indicator circuit with ohmmeter at indicator receptacle. If faulty, replace Gyrosyn Compass Indicator. |
| | Defective tube. | Replace Gyrosyn Amplifier. |
| | Faulty Gyrosyn Compass Indicator. | Replace Indicator. |
| Annunciator shows dot or cross continuously after proper alignment procedure. | Faulty circuit between Gyrosyn Compass Indicator and Flux Valve. | Check for open or short circuit with Flux Valve Continuity Checker T-100870 or equivalent at cable receptacle on indicator end of cable.<br>(Caution: Do not use a d-c ohmmeter across any coils of the Flux Valve.) |
| | Defective tube. | Replace Gyrosyn Amplifier. |
| | Defective Gyrosyn Compass Indicator. | Replace Indicator. |
| Annunciator sticky or sluggish. | Frequency and voltage supplies not within tolerances. | Adjust voltage and frequency to tolerances. |
| | Too much ripple in d-c supply to Gyrosyn Compass Indicator. | Minimize ripple by eliminating any common supply lead to both Inverter and Indicator. The + 28 volt, d-c lead to the Indicator should be connected directly to the d-c bus, so no current for any other unit such as the Inverter, flows through this lead. |

| Trouble | Probable Cause | Remedy |
|---|---|---|
| | Improper shielding of flux valve cable. | The three signal leads from Flux Valve should be shielded from excitation.<br><br>Note: Shield should be grounded to the aircraft frame at the amplifier end only. |
| | Defective Gyrosyn Compass Indicator. | Replace Indicator. |
| Deviation exceeds 1° during compensation check. | Flux Valve not properly compensated. | Compensate (Refer to Operation and Service Instruction Handbook) |
| | Faulty cable between Gyrosyn Compass Indicator and Flux Valve. | Check continuity at connector on the indicator end of the cable. Repair or replace defective leads. |
| | Defective Flux Valve. | Replace Flux Valve. |
| | Defective Gyrosyn Compass Indicator. | Replace Indicator. |
| Compass settles on approximately 30°, 90°, 150° or reciprocals regardless of heading. (The annunciator appear sluggish on most headings and the sensitivity varies.) | One signal lead between the Flux Valve and the Gyrosyn Compass Indicator open, shorted to ground, or two leads shorted together. | Check circuit to Flux Valve using Continuity Checker T-100870 or equivalent.<br><br>(Caution: Do not use a d-c ohmmeter across any coils of the Flux Valve.)<br><br>Open in heading synchro circuit in Indicator. Check heading synchro circuit from receptacle at rear of Indicator. If faulty, replace Indicator. |
| When synchronizing the Indicator to the Flux Valve the Gyro upsets. | Failure of the d-c power supply to the Indicator. | Check the d-c voltage input at the Indicator with the Sperry Power Supply Checker T-100671, or equivalent. It should read approximately 14 volts. |
| Repeater Indication lags Gyrosyn Indicator by more than 3°. | Open cable lead to synchro rotor. | Check cable leads for continuity. |
| | Open synchro rotor. | Replace Repeater. |
| | Sticky bearings. | Replace Repeater. |
| Repeater Indication lags Gyrosyn Indicator exactly 180°. | Open synchro rotor. | Replace Repeater. |
| | Dial or pointer set on wrong null. | Replace Repeater. |
| Jumpy repeater operation with occasional reversal of dial or pointer rotation. | Open cable lead to one leg of synchro stator. | Check cable leads for continuity. |
| | Open synchro stator lead. | Check continuity at receptacle. If open, replace Repeater. |

**Correct any trouble BEFORE take-off!**

tolerated in contact flying over comparatively short distances, when the compass merely indicates direction of heading within reasonable limits. But instrument flight, as for example in executive-plane operation, demands a stable directional reference that is accurate within narrow limits and that will permit making turns to designated headings without overswing or oscillation.

Development of the directional gyro, a mechanical instrument designed to facilitate the use of the magnetic compass, actually made instrument flight more accurate than visual flight. The directional gyro (D.G.) is in no way affected by the centrifugal force of turns, rough air, magnetic disturbances, or to the orientation of the airplane (within limits of the instrument).

Briefly, operation of the D.G. depends upon the principle of rigidity in space of a universally mounted gyroscope. Rigidity, or gyroscopic inertia as it is sometimes called, is the ability of a gyroscope to resist any force that tends to change the direction of its axis. The gyro, or rotor, spins on the horizontal axis, *i.e.* the axis of the rotor is horizontal and the rotor turns in a vertical plane. The rotor is supported in a gimbal ring which is free to turn about the horizontal on bearings in a vertical ring. The vertical ring is free to turn about the vertical axis on bearings attached to the instrument case.

A circular compass card in the horizontal plane is attached to the vertical ring and is seen by the pilot through an opening in the front of the case. The axis of the spinning gyro is established on the horizontal by a mechanical caging level and, upon being freed, the gyro exhibits its fundamental property of rigidity. Thus, the rotar, gimbal ring and card attached to the vertical ring remain fixed in azimuth and the plane moves around them. The card is read in relation to the lubber line, the same as a compass.

The rotor turns in the vertical plane but, during turns, may deviate slightly from the vertical plane of rotation. An erecting mechanism, operating by means of the caging knob on the instrument face, quickly returns the rotor to its normal plane of rotation.

To maintain a given heading in straight flight, the pilot places the plane on the desired heading by using the magnetic compass as a reference. Pushing in the caging knob, the pilot then turns the D.G. to coincide with the compass (or to zero, if he prefers), and then pulls the knob straight out. The D.G. then becomes the heading reference for straight flight and permits making turns to new headings without overswing or other annoying factors. It is well to note that the D.G. is extremely useful during take-off under instrument conditions since it is not affected by the acceleration of the airplane.

It must be remembered, however, that the D.G. should be checked at least every 15 minutes against the magnetic compass, due to the inherent drift of the gyro caused by bearing friction and other factors.

The large increase in size and complexity of modern multi-engine aircraft has created many factors affecting the operation of the magnetic compass. Greater numbers of electrically operated instruments, motors, radio equipments, and associated wiring have created a large increase in the potential sources of compass deviation. The magnetic compass

(*Continued on page 50*)

# Remote-Indicating Compass

(*Continued from page 49*)

compensating mechanism is satisfactory when used with a correction card as long as the deviation (disturbing magnetic influences within an aircraft) on any particular heading is constant. In modern aircraft, however, the deviation on any particular heading is seldom constant due primarily to the plane's complex electrical system and related factors. Thus the use of the correction card is limited.

A logical solution would seem to revolve about placement of a magnetic sensing element at a location on the airplane distant from the disturbing flight compartment. Means then must be provided for transmitting indications of the sensing element to the instrument panel. Hence the name—remote-indicating compass system.

An intermediate step, whereby a simple electrical position indicator repeats the position of a remote magnetic compass, obtains considerable freedom from deviation effects but retains many of the inherent qualities of the panel-mounted instrument.

By combining the long-period stability of the gyroscope with the accuracy of the remote compass, design engineers have created an instrument which fulfills the needs of present-day instrument flight and extends into the foreseeable future by serving as the directional element for the automatic pilot. It is felt that a close look at a representative type will acquaint the reader with an understanding of the present-day remote compass system.

### The Gyro-Magnetic Compass

The Sperry Gyrosyn gyro-magnetic compass *("Gyrosen" is a brand name applied to gyro-magnetic compasses made by Sperry*—Ed. Note) combines the functions of both a Directional Gyro and a Magnetic compass. This flight and navigation instrument is fundamentally a Directional Gyro with a magnetic "sense"—a Directional Gyro synchronized with the earth's magnetic meridian by means of a flux valve. It is in one sense a gyro-stabilized compass, but since it is a directional gyro which is "slaved" to the magnetic meridian, it is more proper to call it a gyro-magnetic compass.

The Gyrosyn Compass fulfills the following basic requirements: 1) It provides a stable directional indication under all conditions of air turbulence; 2) It is North-seeking in the same sense that a magnetic compass is, but without the disadvantages of northerly turning error, oscillation or swinging. It does not drift and, therefore, does not require resetting. It transmits its indications to a compass repeater which can be installed wherever needed in the airplane. Since the transmission system is self-synchronous, the repeater never requires resetting. Its indications are the same as those of the gyro itself; and 3) The system is very light in weight and requires a minimum of space in the airplane. It is simple, both mechanically and electrically, and all parts requiring periodic servicing are readily accessible.

The Gyrosyn Compass consists of four major units: the Flux Valve, the Indicator which is the panel-mounted directional indicating instrument containing the gyro, the Amplifier and the Repeaters.

*Flux Valve:* The flux valve, the direction-sensing component of the Gyrosyn Compass, detects the direction of the lines of force of the earth's magnetic field and transmits this information electrically to a precessing device incorporated in the gyro unit.

The flux valve is very small and light in weight and is sealed so that it may be installed in the extreme tip of the wing, at the top of the vertical fin, or in any other remote location in the aircraft where local magnetic disturbances are zero or at least reduced to such a low value that they can be compensated quickly and accurately.

The flux valve has no rotating parts. It is pendulously mounted from a universal joint so that it normally maintains a horizontal position regardless of the altitude of the airplane. This is necessary because of the fact that the instrument obtains its directional indications from the horizontal component of the earth's magnetic field. In rough air, the pendulous flux valve momentarily swings out of the horizontal position; in fact a continuous short period oscillation is present under all except smooth-air conditions, and the resultant fluctuating signals, if used directly, would be useless for directional indication. The gyro in the indicating instrument, however, consisting of a 20-ounce rotor, electrically driven at 23,500 rpm, reacts at a very slow rate to the "slaving" signals. In this manner, the gyro effectively integrates all short-period fluctuations so that only accurate, deadbeat indications are produced, regardless of the roughness of the air.

The flux valve is composed of a core, an exciting coil and three pick-up coils. Lead wires from the four coils are connected to terminals in the top terminal plate. The element is pendulously mounted inside a hemispherical sealed case. Briefly, the flux valve acts as a detector, sensing its azimuth orientation with respect to the direction of the earth's magnetic field. The core of the flux valve is acted upon by the lines of force of the earth's magnetic field and also by the 400-cycle alternating current flowing through the exciting coil. The exciting flux changes the permeability of the core material and thus serves to pulse the earth's field as it passes through the core. This pulsating flux induces a voltage in the pick-up coils, and the magnitude of this voltage varies directly with the amount of the earth's magnetic field in line with the core. Therefore, as the flux valve is turned in azimuth by the turning of the aircraft, the magnitude of the voltage induced in each pick-up coil varies with reference to the direction of the earth's magnetic field.

The signals originating in the flux valve are carried through cable connections to the Amplifier and the Indicator units.

*The Indicator:* The stabilizing gyro element of the Gyrosyn Compass is basically the same as the standard directional gyro, which is recognized everywhere as one of the essential flight instruments. The Indicator unit comprises the following principal elements:

1) A gyro which spins about a horizontal axis and provides a stable directional reference.
2) A precession or "slaving" device which applies a torque to the inner gimbal ring of the gyro to cause the gyro to precess about its vertical axis.
3) A signal transformer selsyn which relays to the amplifier the displacement signal or angular difference between the gyro's spinning axis and the direction of the horizontal component of the lines of force of the earth's magnetic field.
4) A selsyn transmitter for transmitting the heading of the gyro to the repeaters.
5) A small annunciator for indicating the direction of "slaving". It is used for quickly setting the Indicator to the magnetic heading for initial synchronization, and also serves as an indication of proper operation of the Gyrosyn Compass.

The stabilizing gyro of the Indicator is driven by a self-contained, three-phase induction motor. The rotor and the stator are enclosed in the gyro housing. The gyro housing is free to revolve on horizontal bearings in a vertical gimbal ring. The gimbal ring revolves about a vertical axis on bearings in the upper and lower bearing assemblies.

Because of the characteristic of "rigidity" inherent in the gyroscope, the gyro element remains stationary as the airplane and the case of the instrument turn about it. A pair of gears transmits this relative angular rotation from the gyro element to the face of the instrument.

The directions sensed by the flux valve is transmitted electrically to a signal transformer selsyn which is mechanically coupled to the gyro. Any difference between the indicated and magnetic headings varies the voltage generated in the rotor of the signal transformer. This voltage is amplified and passed through precession coils which apply a torque to the gyro to align it with the magnetic heading.

Incorporated in the Indicator is a leveling device consisting of a leveling switch and torque motor which counteracts any tendency of the gyro to depart from its normally horizontal position relative to the gyro case.

*Amplifiers:* The amplifier contains the vacuum tubes and associated circuits for the amplification and detection of the phase of the signals from the flux valve.

*Repeaters:* Each repeater duplicates the directional indication of the gyro. It contains a stator with a three-pole winding and a rotor coil which is mechanically connected by a shaft to the repeater pointer.

The three terminals of the synchro transmitter stator in the Indicator are connected to the corresponding stator terminals in the repeater. The synchro rotors are energized by one phase of the 400-cycle supply. The voltage in the rotor of the transmitter induces a voltage in each of its three stator windings. The voltages are reproduced in the repeater stator. If the pointer of the repeater does not correspond to the indication of the gyro, a torque will be exerted on the rotor as a result of the interaction of the stator and the rotor fluxes. This results in a torque being applied to the repeater rotor which aligns it with the transmitter rotor. This torque is zero when the fluxes are aligned, which is to say, when the repeater indication exactly corresponds to the gyro indication.

Operation of the Gyrosyn Compass is extremely simple. The electrical supply is turned on and the instrument is initially synchronized by pushing in and turning the knob at lower left of the dial. On the C-2 model, which has a fixed dial and rotating

pointer, there is a course indicator which can be set to the magnetic course by turning the same knob that is used for synchronizing, but without pushing the knob inward.

Before making a turn, the course indicator can be set to the desired new heading, and the airplane then turned until the direction indicating pointer is again aligned with the course indicator.

The repeater also has a course indicator and is used in exactly the same manner as the Indicator itself, except that no initial setting is necessary as the repeater is self-synchronous.

The C-2A model has a rotating dial which is read against a lubber line at the top of the instrument face. The reciprocal heading is shown on the smaller, supplementary dial.

### Specifications

*Current Requirements:* Operates on 115-volt, 3-phase, 400-cycle a-c supply. Power consumption is 25 watts, with a power factor of 0.55. Direct current, 27.5 volts, 0.6 amps.

*Indications:* Magnetic North, without northerly turning error, gyro drift, or resetting. C-2, with rotating dial, has supplementary dial showing reciprocal headings.

*Dial Markings:* Supplied either with fluorescent markings or with fluorescent-radioactive markings.

*Mounting:* Indicator and repeators designed to permit modern instrument grouping. Mounts in 3-3/16 inch diameter cutout with slight additional clearances.

*Repeaters:* Operates up to three repeaters, either rotating pointer or rotating dial type.

*Operating Limits:* Gyro element permits 85° climbs and glides and 85° right or left banks before limit stops are reached. Gyros non-tumbling, no caging mechanism is required.

*Performance:* Provides accurate directional indications over a wide range of temperatures. As the gyro is electrically driven, the instrument meets all the requirements of high-altitude flying.

*Serviceability:* All parts that require periodic inspection are accessible. The flux valve (which is remotely located) requires no servicing.

### System Power Supplies

Airplanes are equipped with various types of electrical power supply. To adapt such supplies to the requirements of the Gyrosyn Compass, which are 14-volt or 28-volt direct current and 115-volt, 400-cycle, 3-phase alternating current, the following adapters are available: Inverters—

1) The 14-volt inverter changes a 14-volt direct-current input into a 115-volt, 400-cycle, 3-phase, alternating-current supply;
2) The 28-volt inverter changes a 28-volt direct-current input into a 115-volt, 400-cycle, 3-phase, alternating-current supply.

Phase Adapter—The adapter changes 400-cycle, single-phase alternating current to 400-cycle, 3-phase alternating current.

### Installation Data

*Gyrosyn Indicator*: The Gyrosyn Compass Indicator should be supported in a shock-mounted instrument panel so that the face of the instrument is vertical and level laterally when the airplane is in a normal cruising attitude under normal load conditions. The instrument panel must be flat so that the instrument will not be strained when the attaching screws are tightened.

*Gyrosyn Amplifier*: The shock-mounted amplifier may be installed at any convenient location. However, a ¾-inch minimum clearance must be allowed between the Amplifier and the adjacent equipment for the motion of the shock mount and for ventilation.

*Flux Valve*: The Flux Valve should be located as far as possible from all sources of local magnetic deviation, such as electrical cables, engines, indicating transmitters, etc. Generally, the best location is in the outer wing panel, as close to the wing tip as possible. Where a wing installation is not feasible, an alternate location in the tail section is sometimes satisfactory.

In a prototype installation, a survey must first be made to determine a location of minimum local magnetic disturbances which will be suitable for the Flux Valve. This survey can be performed as follows: Place an uncompensated magnetic compass in each of the possible locations for an installation. Then turn the aircraft to each of the four cardinal headings and record the compass indications. While conducting the survey, simulate as near as possible actual flight operating conditions by turning on the electrical system, the engines, the radio equipment, and other accessories. Choose the location offering the least magnetic error.

If a suitable, deviation-free location for the Flux Valve cannot be found, a Compensator is required to counteract the effects of this magnetic deviation. This is an auxiliary unit of the Flux Valve and is mounted directly on top of it.

*Repeaters*: This unit (or units) may be installed at any convenient location for use by the pilot, co-pilot, navigator or other crew members. It is mounted from the front or the rear of a panel in a cutout which conforms to its dimensions.

*Gyrosyn Repeater Amplifier*: The Gyrosyn Repeater Amplifier may be installed in any location that is convenient where the ambient temperature does not exceed 40° C. To minimize the length of cabling, a location close to the System Junction Box is suggested. Sufficient space must be allowed for a complete withdrawal of the deck and panel assembly from the case for servicing, also for free motion of the shock mount, and for ventilation.

*System Junction Box*: The System Junction Box is mounted at any convenient location as required by the length of the cables in the power supply, to the Repeaters, to the Amplifiers, and to the Gyrosyn Compass Indicator.

*Flux Valve Junction Box*: The Flux Valve Junction Box is an enclosed terminal board for the leads of the flux valve cabling, and is used when the cable is cut to conform in length to separable sections of the airplane wing. It is fastened to a support in that wing section from which it is least likely to be removed.

*Cabling*: All interconnecting leads between various units must not be smaller than No. 20 A.W.G. stranded single-conductor cable. These leads must be bound together with plastic tubing and black friction tape. Wire leads are usually color coded according to the manufacturer's recommendations for standardization. Safety switches or fuses should be installed in the power supply as

(*Continued on page 60*)

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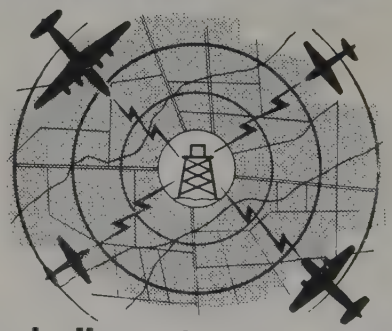

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# Revolution in Research

*(Continued from page 21)*

airframe designs for an atomic-powered bomber.

Greatest change in this "nerve center of air power" which has occurred since the red-influenced North Koreans crossed the fateful 38th Parallel in armed aggression, has been a complete reorganization and streamlining of the research activities. To be more specific: The formation of the Wright Air Development Center under a new and separate Air Research and Development Command.

That move, the result of more than 18 months study by such top men as former AF General James H. Doolittle and deceased General of the Armies, Henry H. Arnold's scientific advisor, Dr. Von Karman and others, has split the responsibilities of research and development from those of supply and maintenance. It is most indicative of the importance, in these times, that is being placed on long-range experimental research and engineering. Behind it was a simple lesson taught us in World War II by the Germans—"never to get caught with our pants down and our brains in our britches." The lesson came knifing down out of the sky in the form of the V-2 rockets and a whole new kind of an air force that Hitler's alchemy of scientists unleashed on the world in the fading days of the *Luftwaffe*.

Today WADC is a brand new infant, born of a necessity when Air Force engineering outgrew its subordinate role of the past. Its primary task is to translate military requirements into performance. It is really a "go-between agency." It serves as an intermediary between science and industry on one hand and between engineering and the tactical and strategic air forces on the other.

Organizationally, it breaks down into seven major divisions. Largest of these is the Weapons Components Division responsible for giving the airplane, bomber or fighter, its electronic brains and brawn, its magic eyes of photography, its firepower punch, bombs or bullets or rockets and all of the necessary auxiliary equipment to make bombsights, autopilots, cameras and other mechanisms work with precision. It runs six big "factories": Aircraft Radiation, Armament, Communication and Navigation, Components and systems, Equipment, and Photographic Reconnaissance laboratories.

Working closely with this complex array of projects is the Weapons Systems Division whose duties include the exploration of new flight frontiers in piloted aircraft and guided missiles. WADC's engineers monitor the complete experimental piloted-aircraft program and conduct research in pilotless aircraft and guided missiles. They are also concerned directly with projects involving military application of atomic energy, special weapons development, radiological warfare and the development of nuclear-powered aircraft.

Another organization, The Aeronautics Division, is responsible for aircraft and missile design and structure problems. Physically, it employs the facilities of the Aircraft, Propeller and Powerplant laboratories.

There is also the Research Division comprising three laboratories—Flight Research, Materials and the Aero-medical laboratory, the latter being chiefly responsible for adopting the highly complex, high-speed modern-day machine to man's comfort and his physiological and psychological limitations.

An old activity which gained for Wright Field the name of "Home of The Test Pilot"—experimental test flying—comes under the Flight Test Division. Its pilots are constantly in the air (more than 2,000 hours a week in all types of aircraft) "wringing them out" to check performance, stability and control characteristics, and to obtain actual in-flight studies of various new equipment items, ranging from a new oxygen hose to a radically shaped airfoil section of the wing of an "X" model fighter.

The remaining two divisions are the Materiel Division and the Engineering Standards Section: the first runs tests on all kinds of materials used by the AF, such as parachute nylon, rubber in the huge bomber tires or a new kind of metal that may be going into aircraft skin. The Engineering Standards Section is responsible for control and coordination of engineering standards governing all materials, components and parts in design, production and maintenance of flying equipment.

That's the way Wright Field looks "on paper" in its new role as the Wright Air Development Center. What makes it a virtually entirely new installation, however, is the way the paper organization puts to practice its myriad of programs.

More than anything else, the progress the Germans made in aeronautical research and development forced our own USAF to put increasing emphasis on the importance of research and engineering. That, alone, changed the face of Wright Field which has long been the focal point of the AF's aviation experiments and testing. It took some of the activities which had been performed here since the days when the USAF was the Air Service—1917-18—and moved them to bigger and more isolated areas. But it also brought a new kind of testing to Wright Field and it made the place expand like a balloon taking on helium.

Consequently, there are some 10,000 ci-

**MARTIN XB-61** is shown here on its launching platform ready to take off with the roar, black smoke and white heat of a rocket auxiliary thrust. XB-61 is a pilotless bomber

vilian engineers and workers in the laboratories at WADC today. Some 2,000 more officers and airmen steer its projects and programming. More test flying but of a different nature, has turned the sky in these parts into a roaring beehive of swooshing jets, thundering propellered giants, egg-beater helicopters—spider-webbed with vapor trails of planes trying to push the ceiling ever upward.

Contrary to the opinion of many, the work here has never died down. Indeed, it has accelerated with the speed of the jets and rockets which were responsible for the revolution. The approximate engineering work force which totaled 6,000 at the end of World War II has been doubled. Millions of dollars were spent on improving old facilities and new ones in 1951. And a planned new facility construction program for 1952 calls for spending another $42,000,000 on new stuff this year.

What happened? The conventional aircraft with which we fought the air battles of World War II—the *Thunderbolts, Mustangs, Superforts*—required one kind of research. But the age of the jets, the *Sabres,* the B-47 *Stratojet,* the new and bigger XB-52, and some super-secret experimental supersonic designs, made this kind of know-how as useless as trying to take a radar fix with a high-school slide-rule. Instead of feeling out the prowess of fighters and bombers in the 300- to 400-mph range, engineers suddenly had to probe into the problems and unknowns of flight at speeds of 500 to 1,000 mph! With the promise that in the next two or three years the 1,000-mph fighter will be a reality.

So far as Wright Field was concerned, it meant taking an installation that was born more than three decades ago (it was then old McCook Field) and which was founded around the propeller and the reciprocating engine and gearing it to the turbine and the tailpipe.

The effect is evident in every nook and corner of the laboratories here. Consider, for example, the transformation that took place in the big powerplant laboratory.

You can stand on a little knoll in back of the main lab building and feel the tremendous change which has swept over the entire place. The earth trembles beneath your feet. There is a disturbing, throbbing sensation in your ears. Staccato blasts cause temporary deafness. A strange, almost nauseating odor whiffs into your nostrils; it smells like gun-powder.

There's good reason. A few hundred yards away, in a new facility they are testing a rocket engine using a new kind of fuel. It's a special power unit for a new-type guided missile.

Nearby is a new dynamometer test stand, one of four which have been changed over to test jet engines and new turbo-prop combinations instead of the old reciprocating piston engines.

One engineer explained the change like this: "Ten years ago 100 per cent of our work here was with reciprocating engines. Today 90 per cent of our effort is with jet engines of all types. There is only one reciprocating engine project still on the active list—the big '4360' which powers the B-50 and B-36 bombers!' "

What he didn't say is that within 18 months, when jet-powered bombers like the XB-52 and the XB-60, the latter a redesigned jet-powered version of the B-36, the 10 per cent reciprocating engine program very likely will sputter out like a defunct carburetor. Our not-yet all-jet Air Force is definitely in the making here.

**TAKE-OFF TEST**—Pulled skyward in a steep climb by the 10,800 total horsepower of her four engines, the *Super Connie* demonstrates its get-away ability. The first seven *Super Constellations* are now in service on Eastern Air Lines

In this laboratory, engineers fought for years a continuing battle—the in-line engine vs. the radial engine; liquid-cooled engines against the air-cooled engines. That battle is over. The one "still-alive" reciprocating-engine project is an air-cooled engine. Today's battle is: axial-flow jets vs. centrifugal-flow jets. Most engineers voice the opinion that this argument, too, is dying out in favor of the axial-flow engine.

"The concentrated effort is pointing toward the axial-flow engine program," one engineer told me.

Within a couple of city blocks of the powerplant lab, another facility whose efforts are closely related to any engine, is acquiring a definite "new look" appearance.

Take a close look and you can slap down those skeptics who claim the propeller-driven airplane is dead. Facts and facilities here prove beyond any doubt that it isn't. They point to the day when planes with propellers will be flying faster than sound.

Listen to these words of prophecy from Adam Dickey, an expert on propellers since the days of old McCook Field in 1917: "Aerodynamically, so far as the propeller is concerned there is every promise of having, in a few years, propeller-driven airplanes capable of speeds of 1,000 mph!"

Here, on the engineer's design boards are supersonic propeller designs which make that day not too far distant. Security prohibits revealing exact details and shapes but

(*Continued on page 54*)

**PIASECKI HUP-2** is the Navy's newest helicopter. Although looking here as though it were about to crash, the Piasecki HUP-2 is merely flipping its tail at the start of a high-speed dash in a demonstration at Philadelphia

# Revolution in Research

(*Continued from page 53*)

there are propellers with eight, 10 and 12 blades; thin-blades that look like razors; blade shapes that form arcs like a Turkish *scimitar* sword, and propeller hubs that resemble pine cones and house a world of intricate mechanisms and secrets.

Already there have sprung up huge new propeller test stands which will permit whirl-testing props at terrific rpm.

The Propeller Lab has also recently acquired a new test responsibility—research into helicopter rotor blades. It now has two huge helicopter rotor test stands which according to the chief of the laboratory, Col. L. M. Taylor—"are the largest of their kind, anywhere in existence, so far as we know." He doesn't say Russia might not have similar test facilities.

WADC has released some details of its new helicopter test facilities. The larger and newer of the two is a Rotor Test Tower. It is 50 feet high, an all-steel frame tower enclosed in a cage comprised of six layers of chain link fence 75 feet high and 100 feet in diameter. The fence serves as protection in case a rotor blade disintegrates during a whirl test.

The tower is constructed to test rotors up to 90 feet in diameter. Recording devices permit accurately measuring a helicopter's lift potential up to 40,000 pounds. A 4,000-hp electric motor drives the rotor during tests.

The test tower permits simulating the critical "hovering position" of a helicopter. It allows engineers to closely study under all simulated flight conditions rotor blade shapes, sizes, hub mechanisms and controls.

A smaller facility is a similar tower only 12 feet high. It can accommodate rotor blades up to 90 feet in diameter and is capable of measuring rotor lift up to 12,000 pounds. A 1,000-hp electric motor furnishes power to turn blades at as high as 500 rpm.

Both facilities are equipped with floodlighting so that tests can be run at night, indicating the speeded-up emphasis the AF is putting on its helicopter program. There is also a new helicopter shop building adjacent to the Propeller Laboratory. Its activity is entirely devoted to the fabrication of new-type rotor blades.

The same tempo of expansion is evident in the big Aircraft Armament Laboratory where recently a $250,000 addition for "engineering work" alone has been added. In addition the Armament Lab has four new gun ranges.

Other new facilities in other parts of the WADC show beyond any doubt the progressive planning and increasing activity here.

Only recently, for instance, did WADC unveil its supersonic wind tunnel research facilities. Now, it can be told, that for the first time in its history Wright Field is engaged in an extensive supersonic research program. It has one supersonic tunnel in operation that can simulate airspeeds up to more than 2,000 mph. The tunnel is small, having a throat section six inches by six inches, but it is performing a mighty important function—testing missile shapes and airfoils in a speed range which 10 years ago nobody even dared venture to prophecy. "This tunnel is the one really pure research facility we have here," explained Col. Jack Gibbs, chief of the Aircraft Laboratory which operates the supersonic tunnel and five others including the world's largest vertical wind tunnel, a silo-like affair for testing free-flight models.

The small supersonic tunnel is used to test small model component parts of aircraft and missiles, Colonel Gibbs said.

He also revealed the existence of a larger supersonic tunnel which has a 24-inch by 24-inch interchangeable test section. The bigger tunnel can stimulate airspeeds well in excess of Mach 2, double the speed of sound.

WADC also spent almost half a million dollars last year to improve its high-speed 10-foot pressurized wind tunnel. It now has a flexible throat test section which permits simulating faster-than-sound speeds. Air rushes so fast through the giant tube, Colonel Gibbs explained, that it was "necessary to build a million dollar ice box around it to keep things from burning up."

Speaking of ice-boxes, WADC also has a huge refrigerator that is as big as an entire laboratory building. It is used for simulating snowstorms, blizzards and cold-weather conditions. Engineers can put a whole airplane fuselage inside and make their own cold.

In the basement of the big Equipment Laboratory they have also designed and built a series of climatical research facilities which permit simulating weather conditions existent anywhere in the world. They call it the "room with the world in it." In one facility they can whip up a sand storm simulating desert operations. Another permits a Pacific fog to be created in a matter of minutes. Still another puts tropical temperatures and humidity inside a box so that fungus can do its dirty work on new airplane parts.

A whole series of test facilities in the Aero-Medical Laboratory are helping to unscramble today's greatest problem facing the Air Force: How much can man stand within his physical limitations? How high can he fly? How fast? For how long? How quick a turn can he make without blacking out? How much heat? How does the pulse beat of a jet engine affect his hearing?

To find out, WADC has a modified human Centrifuge which permits tests for negative G forces as well as positive G forces, has an interchangeable cab for trying out various cockpit arrangements, testing all kinds of seat positions including prone-position beds.

Another very recent merry-go-round test is implemented by a horizontal spin table used for simulating the effects of tumbling. It is a large disc which whirls and whirls and whirls. Strapped to it on its side is a standard-type ejection seat. The subject straps himself in the seat. The spin table spins. It simulates a pilot doing somersaults through the air after a bail out, a fault that has caused great concern to ejection-seat users.

The Aero-Med Lab also has a modified pressure chamber which can stimulate altitudes up to 120,000 feet! That's indicative of some of the new ceilings.

There is also a special sound room where they can produce enough sound to kill a man. But which is designed to measure the various kinds of sounds and their effect on human tolerance.

The list could go on. There are many other lesser test facilities which have suddenly appeared here. All of them are being taxed to the limit. WADC is fighting and winning some important battles some 200 miles north of the 38th parallel on the ground near Dayton, Ohio.

Someday what is going on here may help to decide a war.

# The Delta Wing

(*Continued from page 23*)

ing to Thomas M. Hemphill, project engineer for Convair on the XF-92A since the original basic design was mapped out.

"These early NACA findings showed that the low-aspect ratio wing, particularly the so-called 'pancake' circular airfoil, would not stall," said Mr. Hemphill. "However, the drag of these low-aspect ratio wings was so high at slow speeds that the findings were of no great importance at the time. There wasn't an engine even on the drawing boards that would put out enough power to handle this high drag.

"The advent of the turbojet changed all that. The Delta wing, which won't stall out but will slow down rapidly at high angles of attack, suddenly became practical, since a jet fighter has plenty of power to spare. Thus the Delta-winged fighter, racked up in a turn, will circle in roughly half the space taken by a conventional wing because of its low wing leading, *if* it has enough power to spare to push it around that turn.

"Admittedly, the original Allison J-33A-23 engine without afterburner didn't have sufficient power to do the job, but we built the XF-92A as a flying test stand and built it in a hurry. The whole project started on a shoestring back in early 1946 when the Air Force authorized Convair to produce a high-speed sweptwing single-plane aircraft capable of attaining an altitude and speed surpassing that of any existing piloted aircraft. At that time, three of Convair's top design engineers —Frank Davis, the Cal-Tech graduate engineer who made the first flight in our XF-81, Chief design engineer Adolph Burstein, and Chief Aerodynamacist Ralph Shick of the old Downey division—went to work on the project.

"Following considerable research, these experts found that the Delta rather than the sweptwing design would more readily conform to the high-speed fighter requirements. This theory was further substantiated by Dr. Alexander M. Lippisich, a German scientist now at Wright Field but formerly from the Messerschmitt Aircraft organization. He worked on the Delta design during World War II in Germany. Discussion with the German scientist in Dayton, Ohio, proved very encouraging and Shick returned to California convinced of the Delta-wing's potential.

"The original wind-tunnel model cost only $150, but the results proved so impressive that the Air Force granted permission for us to transfer the original authorization from a sweptback wing to the Delta wing. Over 5,000 hours of wind-tunnel testing—more than on any other plane that Convair has yet built—went into the XF-92A before the original flying test stand was built.

"The XF-92A was partially constructed at the Convair Vultee Field Division and then transferred to San Diego," explained Mr. Hemphill. "My previous project, the Convair Liner Model 240, had just completed its certification tests and the management asked me to take over the XF-92A as project engineer and to get it flying. Still operating on a shoe-string, we built the original plane using parts designed for five other aircraft. The main landing gear came from

(*Continued on page 56*)


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5-52

# The Delta Wing

(*Continued from page 55*)

a Bell P-61 jet, the control stick and brake cylinders are from one of our BT-13's and the tailpipe for the jet engine was modified from our XF-81."

While it has considerably more wing area than conventional fighter planes, the XF-92A is basically the same size. Previously released specifications list the XF-92A as having a wing span of approximately 31 feet, a length of 41 feet and a height of about 18 feet. The gross weight is roughly 13,000 pounds and Major Charles Yeager, speaking before the Institute of Aeronautical Sciences in Los Angeles, mentioned that he had "flown the Delta wing at a speed as low as 70 mph." He also said that power-off landings had been accomplished without difficulty by holding the speed to 30 to 40 mph over the landing speed.

Because it won't stall, the Delta wing lands and takes off with the nose extremely high in the air as compared with conventional jet aircraft. "This high angle of attack on landing should not be considered as a 'real' disadvantage of the Delta wing," explained project engineer Hemphill. "With practice and training, pilots, will become accustomed to the nose-high attitude and actually make safer landings because the dangerous nose dropping and stalling characteristics of the more conventional designs are absent. While the Delta wing can utilize a 30° angle of attack, we limit it to about 20° by limiting elevator travel. Just to see what the pilot was up against, I went out to a nearby airport and shot landings many afternoons in a *Cub* which most pilots land at over 50 mph. By leveling off high and getting the nose all the way up—as in a Navy carrier landing—before touching the ground, I was able to land consistently at 42 mph. Just as in the XF-92A, it puts the pilot in a physically uncomfortable angle, but it is the most efficient 'CL Max' (maximum lift coefficient) and makes the best landing in the Delta wing."

A pure Delta wing has a sweep from the nose of 60°. The Convair flying test stand is exactly 60°. Wind-tunnel tests show that the flight characteristics, mainly at stalling speeds, are changed markedly at more than 5° deviation on either side of the symmetrical equilateral triangle. Planes like the *Cutlass* F7U shipboard fighter are merely low-aspect ratio wings, not true Deltas. They require slots, flaps or similar devices to achieve high lift. Current British releases list the Boulton Paul P111 powered by Rolls-Royce *Nene* Turbojet and the Fairey FD-1 with a Rolls-Royce *Derwent* turbojet as modified Delta configurations. The true Delta Avro 707B and the Boulton Paul P111 are equipped with anti-spin parachutes which might tend to prove skepticism to the inherent stability of the British design.

Writing for a recent issue of the "*London Sunday Times*," correspondent E. Colston Shepherd stated that "*a still more exciting prospect for the fighter is held out by the Delta wing if practice can be shown to comform with theory. It is the prospect of fitting the fighter into the cone of the shock wave which breaks about the aircraft as it exceeds the speed of sound. The theory is that this cone of the shock wave narrows as the speed rises and that the triangular wing can be designed to fit into the cone appropriate to its top speed much as a finger fits into a glove . . . and theory says that this limit will not affect the Delta wing until a top speed of 1500 mph is reached. That is roughly twice the speed of sound.*"

While performance figures on military aircraft, particularly experimental prototypes, are definitely a thing of the past, pilots and designers alike comment on the smoothness with which the Delta configuration is designed to pass through the sonic barrier.

One unexpected flight characteristic rather surprised the pilots who have flown the XF-92A. Because of the location of the large rudder and fin directly behind the pilot, there is considerable side force in the cockpit, like an auto in a skid during a turn. This, like the nose-high angle on take-off and landing, produces a new sensation to the pilot but is one to which he can accustom himself. It is not necessarily an inherent disadvantage of the design.

The Delta wing has an extremely fast control reaction. A non-reversible control system governs both the rudder and elevens that act both as elevators and ailerons on the trailing edge of the Delta wing.

### *Delta Building*

A rough estimate of the Delta's being 20 per cent easier to build than a conventional aircraft appeals to the potential manufacturer of a Delta-winged plane. By eliminating the tailplane and supporting fuselage, omitting flaps, slots, brakes and the corresponding pilot controls necessary in conventional sweptback aircraft, a considerable part of construction cost is avoided. Add the foot-thick wing section which is easy to "beef up" to eliminate transonic flutter, and you have a structure that a production engineer would completely enjoy. Normally, thick wings are not conducive to high speed, but it should be remembered that the wing section of the Delta is not as thick in percentage of the wing chord as a regular sweptback-wing fighter. Since the chord is roughly 70 per cent greater than the regular design, the thickness is actually a smaller percentage of the chord than on the regular design, and it is this percentage of thickness that causes that "old devil drag."

As long ago as June 1949, Convair's Vice President in charge of Engineering, R. C. Sebold, said, "research to date points to the possibility that the Delta wing will develop into the standard configuration for supersonic flight." *(Skyways, March, 1950)*

Recently, the Air Force announced that the XF-92A would soon be transferred to the NACA for additional testing and evaluation of flight characteristics. NACA pilots will fly the airplane to obtain performance figures at all speeds and CG loadings. This work will undoubtedly continue at the Edwards Air Force testing center because of the ideal terrain and broad dry lake.

As for the Delta-wing design itself, a United Press story out of Washington reported recently,

"*The Air Force is preparing to order test models of a delta-wing interceptor fighter with such highly developed automatic electronic controls the pilot will be going along for little more than a ride, informed sources disclosed today.*

*The plane is the XF-102, which will be built by Consolidated Vultee Aircraft Corp. Many months are expected to elapse before it is ready for combat.*

*The automatic pilot and firing system were developed by the Huges Aircraft Co. Details are top secret. But they were designed to put the fighter in a position to shoot down an enemy bomber at high altitudes by radar controls. The pilot would only monitor the controls.*

*The plane also is expected to carry a guided missile that would be fired automatically when the interceptor reaches the right distance from the bomber to be sure of a 'kill.'*

*The XF-102 was designed to fly faster than sound. Sound travels at about 760 miles an hour at sea level but the rate goes down to 663 miles above 35,000 feet altitude—where interceptors probably will have to do their lethal work.*

*The plane also was designed for a terrific rate of climb, a most important thing to an interceptor.*

*Informed sources said that the unconventional craft will be powered by a Pratt & Whitney J-57 jet engine, the same powerful engine the B-52 Superbomber has.*

*It is rated unofficially as having about 10,000 pounds thrust, or horsepower, at 375 miles an hour. The equivalent horsepower of jet engines goes up as the speed increases.*"

So the Delta Wing, named after the fourth letter in the old Greek alphabet may possibly come of age. The orphan of the aerodynamacists that was the butt of many an unkind word when it first appeared at Edwards Air Force Base—remarks like "My kid designed better looking airplanes than that in the second grade," and "That's an overgrown paper dart if I ever saw one."—may have the last laugh after all.

Credit the endless hours of painstaking research on the part of NACA, independent aerodynamacists and Convairs own staff of slide-rule experts for taking a formula nearly 20 years old and producing a completely unconventional product that may well be the blueprint for tomorrow's airplane.

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# Dilbert

(*Continued from page 33*)

the accuracy of this bearing and asked for a repeat; and then another bearing. "No change, 214°."

Dilbert then "reluctantly" flew on this heading, thereby committing another grievous error.

For a glance at his map, or familiarity with the terrain around the base, would have shown instantly that the bearing could not be correct, or they would then be over land. Whether it was a reciprocal bearing, or entirely erroneous, was never cleared up.

What finally happened? Oh, about the time the gasoline supply was exhausted, 160 miles south of base, a tramp steamer hove in sight, Dilbert landed alongside, and they got picked up.

What's to learn from this? At least that in the air, as on the land, as on the sea, there is no substitute for common horse sense.

Don't you depend on a tramp steamer to cover up your faulty navigation.

**That Ground Loop Bogy**—Dilbert made a perfect landing. Half way through the runout he stuck his head down in the cockpit to check his gas gage and raise his flaps. He was only down there a few seconds, but when he reappeared his plane was in a well-developed gr-r-round loop.

Better, much better, had Dilbert remained out of sight until it was all over, for he only succeeded in complicating things. By excessive and improper use of his throttle-rudder-brakes combination, he managed to turn a simple ground loop into a noseover, with much extra damage.

Perhaps the most noteworthy thing about this very unoriginal accident was the vociferous argument it started among three witnessing pilots. Each loudly insisted Dilbert had made certain mistakes; each had a different answer; and no one listened to a word the others were saying. This tense situation was broken only when they became aware of the humorous tableau they presented.

Strange to say, these pilots were all experts. Which helps prove there must be more than one correct way to prevent a ground loop. Everyone is agreed that to prevent a ground loop all you have to do is land in a straight line and keep your plane running down that line until you have slowed to taxi speed. How best to maintain that straight line, by what combination of throttle, rudder, brakes; that is what causes the big argument.

Actually, there is no single correct answer; whatever action will accomplish this is correct. Here are a few reminders. Be sure your tail wheel is locked. Rudder is only effective while the plane is traveling at high speed. During this period, it will save your brakes and tires. A touch of gun may increase rudder effectiveness, but be careful—your engine will only accentuate a well-developed ground loop. On the other hand, brakes are effective all during the run and are, undoubtedly, your most dependable ally.

Nothing will help you, however, if you don't keep your eyes focused far enough in front of you to detect those ground loops while they are still in embryo. Most ground loops are caused by carelessness; pilots fail to concentrate far enough ahead to be able to detect the start of a ground loop. That's when they are easy to correct. Confucius must have been referring to this when he said, "ounce of prevention worth ton of cure."

"Accident prevention begins in the cockpit and the best preventative is you, the pilot"

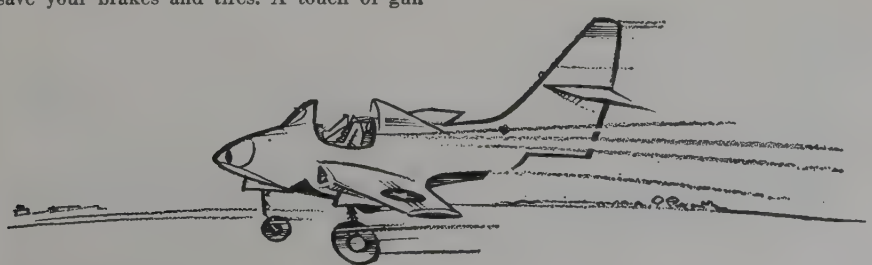
**Snafu**—Did you hear what happened to Dilbert and one of his students last winter? With the student at the controls, they were attempting a take off in a small twin-engine job. But let Dilbert tell it.

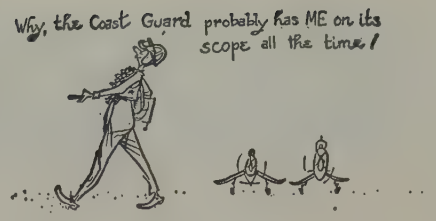
"Shortly after the student gave her the gun, the plane swerved into a ground loop. He recovered from this without damage, and proceeded to take off again. Everything was going fine until just before we had flying speed. The student's earphone cable got tangled around the stick. This made us swerve again; only this time we went head-on into a bank of ice and snow.

"Neither of us was seriously injured, but the plane was a washout. I don't think this student has much natural flying ability."

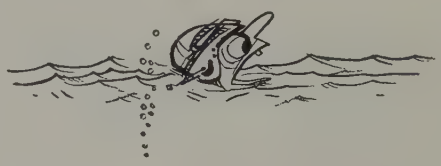
Look who said it. As a result of this accident, they are even now designing a three-seater, so they can carry a second safety pilot to watch the safety pilot.

**The Little Things**—It was such a little thing, that small hole in his life jacket. And Dilbert wasn't a sissy. Besides, he wasn't going to be flying over much water. So he took off and promptly forgot about it.



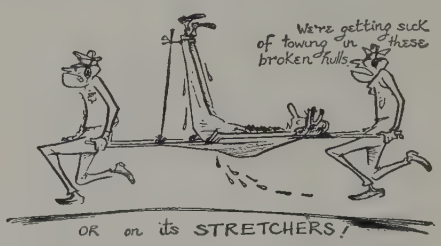



Two hours later, while flying over very rough country, his engine began to cut out. There was no landing area in sight, so he headed for the coast (Dilbert, your life jacket!) and managed a landing a hundred yards off shore. The landing was hard, partly due to the rough sea conditions, and the airplane sank before he was able to get out the life raft.



It was then he wished he had exchanged his life jacket back there before take off. That would have been the sensible thing to do, for it would have insured his getting ashore safely.

As it was, it almost cost Dilbert the works




It took three men and a pulmotor, after he was washed ashore, to drain out his lungs and get those old bellows working properly again.

## SETH'S SAFETY QUIZ

1. Will it require a longer run to take off at sea level, where the air is more dense, than at 5,000 feet?

2. In modern airplanes, as long as you are not overloaded, it doesn't make any difference how the weight is distributed. True or false?

3. What is the only direction you should ever walk on a taxi strip?

## SAFETY QUIZ ANSWERS

1. No—shorter; approximately half as long. In dense air it requires less airspeed to become airborne.

2. False; it is always *weight and balance*.

3. Across it at right angles, so your back can never be turned toward a taxiing airplane.

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*(Continued on page 60)*

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# Remote-Indicating Compass

*(Continued from page 51)*

required by installation regulations. It is recommended that the Gyrosyn Compass operate directly through the main electrical supply switch of the airplane.

### *Operating Instructions*

*Starting*: The Gyrosyn Compass is usually connected directly to the main power supply of the airplane. Therefore, switching "ON" the aircraft power supply starts the operation of the instrument. Allow two to three minutes for the rotor of the gyro to come up to speed; it is then ready for setting. Auxiliary switches are not recommended.

*Setting the Instrument*: When power is applied and the instrument begins to operate, the gyro precesses in azimuth under the influence of the Flux Valve at the rate of 3° to 6° per minute. Since a comparatively long period of time would be required for synchronism of the Indicator and the Flux Valve, the instrument should be synchronized manually during ground run-up or just prior to take-off. This procedure is described in the following paragraph.

Note the symbol (x or •) appearing in the annunciator window at the upper right-hand rim of the Indicator (C-2A, page 25). Press in the knob at the lower left-hand rim of the Indicator and, with pressure on it, rotate the knob in the direction indicated by the arrow for the corresponding symbol (x or •) on the knob. This action will align the gyro and the Flux Valve, and will clear the window of the symbol. From this time on the Indicator will act automatically.

*Using the Instrument*: During flight, because the fundamental unit of the Flux Valve is usually swinging, the dot and the cross are alternately appearing in the annunciator window. This alternate appearance is normal; in fact, it is a sign that the Gyrosyn Compass is working properly.

After the knob has been set properly, the indicator is referred to in the same manner as a directional gyro for maintaining straight flight. By controlling the airplane to keep the indices aligned, the airplane will be flown on a constant heading.

*Operating Limits*: The gyro in the Gyrosyn Compass Indicator is free to operate within 85° from level flight in dive and climb, and in left and right bank. At the limits, it strikes mechanical stops which render the indications of the instrument inaccurate. If the operating limits are exceeded, it is necessary merely to re-synchronize the instrument as described for ground run-up.

The fundamental unit of the Flux Valve remains pendulous through 30° on both sides of the vertical in pitch and in roll. When these limits are exceeded, the spider picks up the vertical component of the earth's field which distorts its sensing and thus gives false signals. This results in small temporary variations during accelerated turns. Restoration of the airplane to an attitude within these limits renders the unit pendulous again, and it automatically resumes correct sensing.

A slaving cut-out switch may be supplied as optional equipment and is used when sensing on the part of the Flux Valve is not wanted, or when operating over portions of the earth's surface where the horizontal lines of magnetic force dip at an angle of 84° or more. With the switch in the "OFF" position, the system may still be used temporarily as a turn indicator, provided conventional procedures for making gyro drift corrections are followed.

### *Daily or Preflight Inspection*

Prior to the first flight of the airplane each day, turn on the main power supply to start the operation of the system. As soon as power energizes the system, the gyro will start rotating. Wait at least three minutes for it to come up to operating speed and to level, then appropriately clear the annunciator window of either the dot (•) or the cross (x) by means of the synchronizing knob. The heading indication should agree with that of a deviation-card corrected magnetic compass. Compare the indications of the Repeaters (if used) with that of the master indicators; they should agree within 2°. Failure to synchronize and/or failure of the Repeaters to synchronize within the expected tolerance should be investigated. *Correct any trouble before take-off.*

The trouble chart (*pages 48, 49*) is designed to narrow the area of trouble to an individual unit, the power supply, or the interconnecting wiring. Overhaul or repair of the defective unit must be performed by qualified personnel only.

CLASSIFIED ADVERTISING

*(Continued from page 59)*

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**AIRPLANE** Buyers and Sellers! Deal direct and save time and money. We have every type of airplane listed at prices hundreds of dollars less than those asked by brokers, because there are no commissions or middlemen's fees to pay. We tell you who own the airplanes you are looking for, you contact the owner, and make your own deal. That's all there is to it. Seller's only fee is $5.00 to list an airplane (include a description up to 40 words). Send $1.00 and you receive listings of aircraft for sale. Save hundreds of dollars. Write today! Aircraft Listing Bureau, 1907 Archer, Chicago, Illinois.

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# NAVICOM

## Airlines Consider Polar Routes

### New Arctic navigation techniques are entering civilian application

Air traffic near the North Pole, now almost on a daily basis, is approaching the point where international airline routes may be added as short cuts between Europe and North America. And navigation techniques developed by U.S. and Canadian military services are finding their way into civilian practice.

At least two airlines have demonstrated more than passive interest in air routes over the top of the world. An Alaskan airline is applying for a regular trans-arctic route to the British Isles. Scandinavian Airlines (SAS) is reported preparing a route from the west coast of the United States to Norway and Sweden. Although denying existence of any flight activity SAS admits active interest in the route.

Neither route will pass directly over the North Pole. But they will cut through the Arctic circle and through latitudes well into the 70's where all the problems peculiar to polar navigation are present. (An over-the-pole great circle route from any North American territory but the northern-most point in Alaska would lead into Russian territory.)

Value of the SAS route would be to make Europe directly available to west coast business men. It would also provide a more direct route between Europe and Japan where trade is growing at a fast pace. The great circle U.S.-Scandinavian route would involve possibly not more than one refueling stop (most likely at Thule, Greenland) while the present Atlantic route has not less than two stops plus at least one change of equipment. The average flight now makes four stops.

Present Arctic air traffic includes:

1. Flights every other day by USAF weather reconnaisance B-29's (Ptarmigan flights).
2. Regular training missions of military air navigation schools.
3. Ever increasing high latitude flights by Canadian bush pilots to small settlements in Northern Canada.
4. Scheduled flights to Arctic circle bases by Canadian Pacific Airlines.
5. Air Traffic between Alaska and the Northwest Territories.
6. Numerous experimental air missions and survey flights over the Arctic regions.

Each of these flights demonstrates the feasibility of regular Arctic flying and helps develop better techniques to overcome the problems peculiar to high latitude navigation.

Sometimes the "peculiar" in Arctic navigation seems paradoxical. Around 77° N. latitude, a pilot flying due west can keep pace with the sun's passage as long as his fuel holds out simply by holding a ground speed of 200 knots. By flying *north* at *midnight,* he can have the unique experience of watching the sun rise *dead ahead!*

Some of the basic problems are:

1. Within 1,000 miles of the magnetic pole, the directive force is so low that the magnetic compass is useless or unreliable. (The magnetic pole is now located in the northwest bay of Bathurst Island, about 400 miles northwest of the position shown in most atlases and popular maps.)
2. Because meridians converge rapidly in high latitudes, the true heading of a great circle course can change as much as 5 to 10° in 100 miles of flight.
3. Because it is easy to approach the

*(Continued on page 62)*

**ROUTINE FLIGHT** that turned out to be longest ever made in a C-54 was a 3,980-mile trip from Fairbanks, Alaska to Oslo, Norway, made Sept. 17, 1949 by USAF 10th Air Rescue Squadron. It was also the first non-stop flight between Alaska and the European mainland

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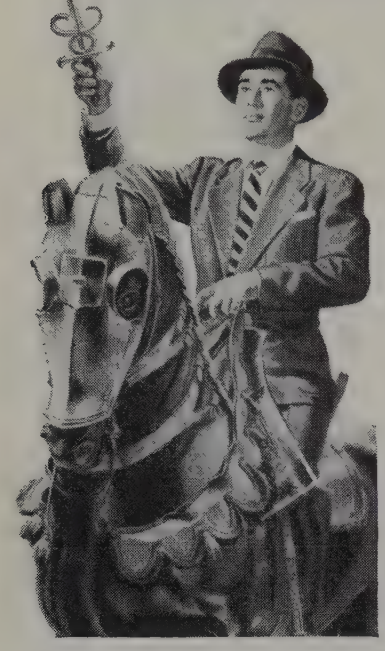

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**AMERICAN CANCER SOCIETY**


## Airlines Consider Use of Polar Routes to Europe

*(Continued from page 61)*

speed of the sun's track, it is possible for twilight to last throughout an entire flight. Twilight makes celestial position fixing impossible.

4. Maps and plotting charts are often inadequate. Although outlines of land masses have been detailed accurately by aerial photo surveys, lack of control stations makes the true position of the bodies of land doubtful.

Adding to these problems are lack of VOR and other radio aids. The few aids existing in the Arctic are mostly non-directional radio beacons used for radio compass homing. Arctic navigation also antiquates many instruments.

In spite of these difficult-sounding problems, Arctic navigation has progressed rapidly since World War II to the point where it is becoming a refined art which involves reasonably simple methods. Foundation of Arctic navigation is celestial sighting. The primary steering technique is "grid-gyro" dead reckoning. The most important secondary aid is airborne search radar.

Celestial observations provide position fixes and steering references. Position can be fixed only when two or more suitable celestial bodies (sun and moon, or two stars) can be seen. If only one body is available, only a steering direction can be obtained.

Celestial methods when properly methodized and instrumentated can be used by the pilot of a single-engine aircraft if necessary. This was demonstrated by Capt. Blair's non-stop flight from Fairbanks, Alaska to Norway.

A new version of the Kollsman periscopic sextant has been developed especially for the polar navigator. An azimuth circle and lens system incorporated in the new design permits the sextant to double as an astro compass. Pre-computed headings can be set in so the celestial sight will show the heading error of the airplane. This information is used to reset the gyro.

Direct celestial sights are impossible during twilight periods. Aircraft in these zones must rely on dead reckoning. The Pfund sky compass, however, is said to overcome this problem by making it possible to obtain steering azimuths from the sun's twilight in the sky.

Since the magnetic compass cannot be relied upon in the regions near the magnetic pole, steering must be done by gyro. Although Blair navigated successfully by a standard air-driven directional gyro, larger planes use a gyro magnetic compass such as the Gyrosyn with the magnetic slaving servo turned off. This permits the gyro magnetic compass to function as a free directional gyro.

Polar navigators use a scheme of "grid" lines to simplify the problem of the ever-changing angle between the course and the rapidly converging meridians near the pole. Grid lines are a set of lines drawn parallel to a convenient meridian on a Lambert polar map. This map looks similar to what an observer sees when he looks straight down on the polar area of a globe.

For navigation in northern Canada, the grid lines are usually drawn parallel to the 180° meridian. Thus a pilot at 90° W. longitude flying due west would have a grid heading of grid north. If he flew true north, his grid heading would be grid east.

Next in importance to the polar navigator is airborne search radar. However radar does not give the same assistance as at lower latitudes. Snow-covered land and ice-covered seas give a scope pattern that can be misleading. In winter, low islands look like water while water looks like land. Pressure ridges in the ice cause false coast lines to appear on the scope. Real coast lines are sometimes hard to detect because of lack of contrast between low snow-covered land and ice-covered sea. Also, in the more poorly mapped areas, one fjord will look just like the next to the radar navigator.

Most reliable use of radar is as a ground speed and drift indicator. In spite of the difficulty in outlining land masses on radar, it is easy for the navigator to check his wind drift and ground speed on the many terrain echoes that exist. This information is extremely important to accurate dead reckoning.

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## Allison Radar Sets To Be Built by New Manufacturer

Allison Radar Corp. has completed negotiations with an "East Coast manufacturer" for production of Allison-designed radar sets for commercial aircraft, Donald K. Allison stated in an interview with SKYWAYS.

(At press time, the radar designer regretted that he still had to withhold the manufacturer's name for later announcement.)

Production models for the radar will bear the name of the new manufacturer instead of the Allison Radar Corp. name. Activities of the Allison Corp. will be confined to design and development.

Mr Allison pointed out that a new model of the radar will incorporate an automatic warning system which will operate whenever the airplane approaches within a dangerous range of a target.

---

## Sperry Analyzer in DC-3

First engine analyzer for Esso Shipping Company was installed in their super-delux DC-3 Executive transport by Executive Aircraft Service of Dallas, Texas.

The electronic trouble shooter which detects, locates, and identifies engine troubles

in jig time is expected to pay off by reducing ground maintenance time and help keep the two P&W R-1870-35 engines in top-notch condition.

The airplane, a C-47 converted by Executive Service, also carries a Zero Reader flight director, C-2 Gyrosyn compass, two radio magnetic indicators, omni-bearing indicator, Collins navigation receiver, radio altimeter, and an A-3 automatic pilot.

Other innovations include retractable tail wheel, JATO, an air-conditioning system which heats or cools the airplane while on the ground, picture windows aft, and DC-6 type berths.

Picture shows Esso's maintenance chief, Harold Lamm, checking engine trouble patterns on the engine analyzer's cathode ray indicator.

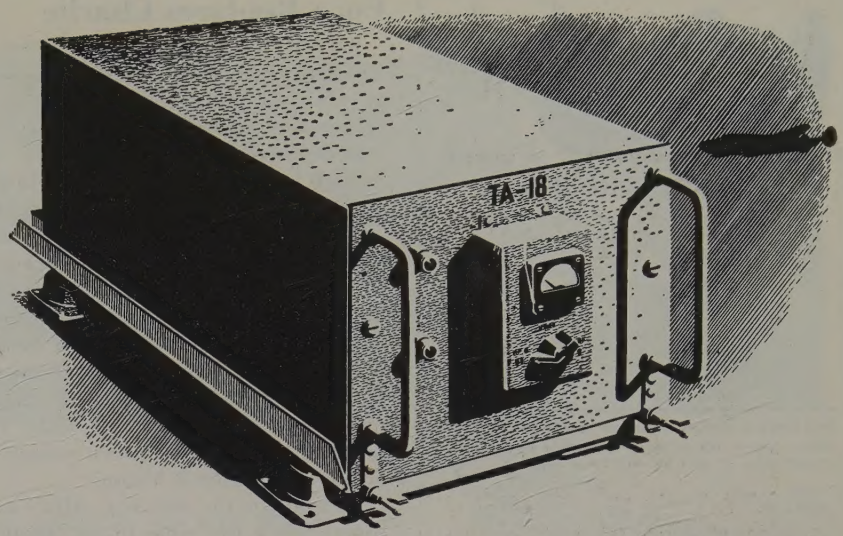
## Statute to Nautical Miles

According to an announcement by the CAA, all speeds and distances will be expressed in knots and nautical miles respectively after July 1, 1952. We had better familiarize ourselves with these terms.

A nautical mile is 6,080 feet as compared with 5,280 feet for the statute mile. Since the nautical mile is equal to one minute of latitude, it is much easier to navigate in terms of nautical miles.

Here's a conversion table for statute and nautical miles (to the nearest hundredth).

| *Statute* | *Nautical* | *Nautical* | *Statute* |
|---|---|---|---|
| 1 | 0.87 | 1 | 1.15 |
| 2 | 1.74 | 2 | 2.30 |
| 3 | 2.61 | 3 | 3.45 |
| 4 | 3.47 | 4 | 4.61 |
| 5 | 4.34 | 5 | 5.76 |
| 6 | 5.21 | 6 | 6.91 |
| 7 | 6.08 | 7 | 8.06 |
| 8 | 6.95 | 8 | 9.21 |
| 9 | 7.82 | 9 | 10.36 |
| 10 | 8.68 | 10 | 11.52 |
| 20 | 17.37 | 20 | 23.03 |
| 30 | 26.05 | 30 | 34.55 |
| 40 | 34.74 | 40 | 46.06 |
| 50 | 43.42 | 50 | 57.58 |
| 60 | 52.10 | 60 | 69.09 |
| 70 | 60.79 | 70 | 80.61 |
| 80 | 69.47 | 80 | 92.12 |
| 90 | 78.16 | 90 | 103.64 |
| 100 | 86.84 | 100 | 115.16 |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## Coca Replaces Charlie

Alfa-Bravo-Coca, new commentator with a distinct internation accent, officially replaced aviation's eminent spokesman, Able Baker Charlie, on all U. S. AirCom networks April 1.

A. B. Coca et al, a colorful international schooled by ICAO linguists, has a more scientific background involving several years of study before adoption by ICAO member nations. Experts who know believe Alfa's world-wide fame is a sure bet because of a rich heritage which mixes Whiskey and Papa with Romeo, Juliette, and Foxtrot, not to mention Yankee, Tango, and Zulu. Only point of agreement between young Alfa and retiring Able is Victor.

Reason for the switch is Alfa's words sound much the same in all languages.

Use of the new ICAO international alphabet will *not* be mandatory for pilots within the United States, the CAA pointed out. But radio replies by all CAA personnel will use the new alphabet "when appropriate."

CAA administrator Charles F. Horne stressed CAA'c desire for all pilots to increase their use of CAA radio facilities regardless of forms procedures, and alphabets. "By this method, domestic pilots will gradually become accustomed to and may adopt the new alphabet," the CAA indicated.

The new and old alphabets are:

| | NEW | OLD |
|---|---|---|
| A | Alfa | Able |
| B | Bravo (Brah'voe) | Baker |
| C | Coca | Charlie |
| D | Delta | Dog |
| E | Echo | Easy |
| F | Foxtrot | Fox |
| G | Golf | George |
| H | Hotel | How |
| I | India | Item |
| J | Juliett (Jool ee yet') | Jig |
| K | Kilo (Kee'loe) | King |
| L | Sima (Lee'mah) | Love |
| M | Metro (Met'roe) | Mike |
| N | Nectar | Nan |
| O | Oscar | Oboe |
| P | Papa (Pop'a) | Peter |
| Q | Quebec (Kay beck') | Queen |
| R | Romeo | Roger |
| S | Sierra | Sugar |
| T | Tango | Tare |
| U | Union | Uncle |
| V | Victor | Victor |
| W | Whiskey | William |
| X | Extra | X-ray |
| Y | Yankee | Yoke |
| Z | Zulu | Zebra |

## Pictorial Indicators Developed for the OBD System

Pilots are one step closer to future easier-to-fly all-weather navigation aids because of installation of 15 DME stations between New York and Chicago.

The distance measuring stations, which have been added at each of 15 airway omni stations, make possible the first enroute evaluation by CAA of new experimental pictorial indicators designed to simplify flying the omni-bearing-distance (OBD) air navigation system.

Three basic types of indicators have been developed for CAA by Aero Electronics Co., Arma Corp., and Sperry Gyroscope Co.

Pictorial indicators consist of a circular VOR-DME map and a "bug" or stylus which pinpoints the airplane's position on the map. The Aero Electronics is small enough to be held on the pilot's lap and can be tucked out of the way when not in use. The Sperry united mount on the instrument panel, plots the plane's ground track by a dry facsimile process, and shows heading information. The Arma unit contains a complete set of maps on film which can be selected at will and projected on a translucent screen.

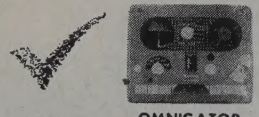
Other versions include course computers which can operate a cross pointer meter, flight director, or automatic pilot.

Pictorial indicators are expected to become the standard navigation method for flying the OBD system. Development experts note that pictorial indicators are more than mere orientation aids and will probably be used as primary flight instruments to give heading, etc.


narco Check List

**HIGH PERFORMANCE—LOW COST RADIO EQUIPMENT**

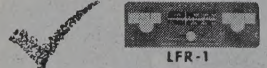
There have been more NARCO VHF communication and Navigation systems sold than all others combined. Use this handy check list for your needs... See your convenient NARCO dealer. If you don't have his name write to the factory. You'll receive prompt reply.



OMNIGATOR — Complete system, OMNI, VAR, 8 channel VHF Transmitter—tuneable VHF Receiver, ILS localizer, 75 mc Marker. Weighs only 18½ lbs.

OMNIHOMER — Low-cost OMNI and 4 channel VHF Transmitter and tuneable VHF Receiver. Built-in power supply, easy to install, weighs only 10½ lbs.

VGTR-1 — Ground station for operators, Two Way VHF, crystal controlled easy to install and operate.



LFR-1 — Range and Broadcast receiver, fits anywhere, small size, only 35 ozs. complete.

VTLR-1 — VHF 8 channel transmitter and low frequency receiver all in one unit. Ideal for small planes. Weighs 7.4 lbs.

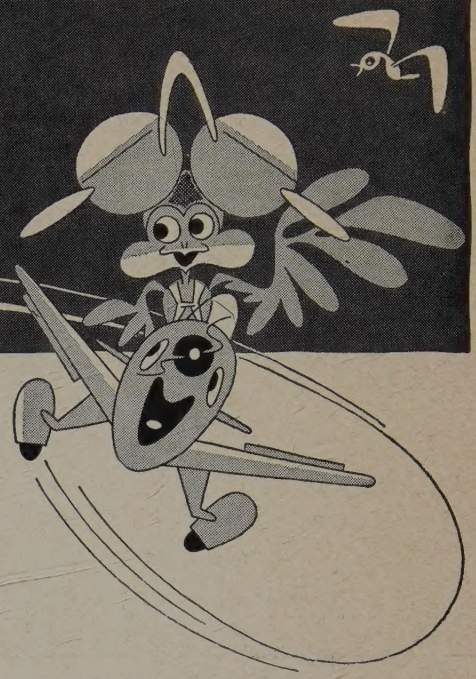
EVERY NARCO UNIT COMBINES HIGH PERFORMANCE, LIGHT WEIGHT AND LOW COST!

narco NATIONAL AERONAUTICAL CORPORATION

AMBLER, PA.

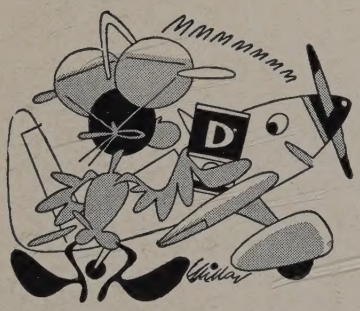
Perfection in electronics

# What's the right oil for *your* airplane engine?



**You've heard so much** about aircraft oils you probably want to know which one is best for *your own engine.* Good idea. You'll fly more safely, no matter what type of engine your plane has, if you use the *right* oil for your engine type. For example:

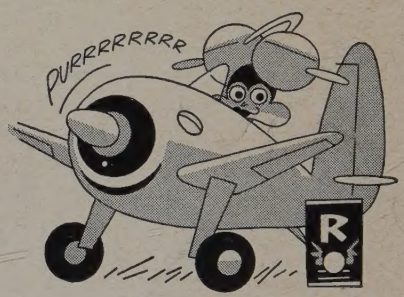
## Horizontally opposed engines need Gulfpride Aviation Oil Series-D!




**Here's the world's** finest detergent-dispersant aviation oil. It's made *exclusively* for use in horizontally opposed engines. Because it is put through Gulf's exclusive Alchlor Process to remove extra amounts of carbon-and-sludge formers, Gulfpride Aviation Oil, Series-D, prevents ring and valve sticking . . . maintains a cleaner, better operating condition longer.

Actually, users have increased periods between engine overhauls as much as 100% with this great oil!

## For radial engines or where a detergent oil is not desired, use Gulf Aircraft Engine Oil Series-R!




**Assures superior performance** in radial engines. Especially recommended for maximum operating periods between overhauls, it may also be used in horizontally opposed engines when operating conditions do not require a detergent oil.

A fine-quality, non-detergent, straight mineral oil, Gulf Aircraft Engine Oil, Series-R, is highly effective in retarding sludge formation. Maintains its body at high operating temperatures, too.

GULF
AVIATION PRODUCTS

### For More Flying Fun—Don't Settle For Less Than Gulf!

**And remember**—the Gulf Airgide Directory lists Gulf airport dealer locations and many others throughout the U. S. and Canada. Comes in mighty handy. Get your copy from your Gulf dealer.

# Q. When is a PIPER not a CUB?

## A. When it's the fast Cross-Country Pacer or Tri-Pacer

Let's be frank about it. When some people think of Piper they still think about the famous J-3 Piper Cub—loved by hundreds of thousands who learned to fly in it, but never famous for speed, range or comfort.

The only points of similarity are flying ease, rugged construction and dependability which are built into all Pipers from the experience of manufacturing more than 35,000 planes over more than two decades. Otherwise, the Pacer and Tri-Pacer are in an entirely different class. In fact, in a class by themselves. For no other four-passenger airplane gives you such solid cross-country performance with such satisfactory economy.

Here's what you get in the 1952 Pacer and Tri-Pacer: SPEED – better than 120 mph. (134 mph cruise with controllable prop for Model 135). RANGE – better than 575 miles. CLIMB – ample to enjoy the pleasure and economy of upper-air flight. COMFORT – sound-proofing, adjustable front seats, plenty of room. ECONOMY – far lower operating costs than any other four-place airplane.

We all love the Cub. But it's a cousin far removed from the new Pacers. Lots of people know that, too. More of them bought Pacers and Tri-Pacers in 1951 than any other four-place airplane. Let your Piper dealer demonstrate this remarkable airplane. For his name and free colorful brochure write Dept. 5-K.

**You'll Like These Advanced Pacer Features**

**TRICYCLE GEAR.** The Tri-Pacer is even easier to fly than the Cub. It virtually lands by itself. Interconnected controls permit flying with wheel alone. Tri-Pacer costs less than half the price of any other 4-place business plane with tricycle gear. Ideal in high winds.

**NEW WIDE GEAR.** Standard Pacer gear is 12 inches wider on '52 models for fine, stable handling characteristics on ground. Hydrasorb landing gear smooths out even the roughest fields. New bubble windshield for added speed, strength and visibility is one of many other fine new features.

**PIPER** AIRCRAFT CORPORATION
LOCK HAVEN, PENNSYLVANIA

### FOR UTILITY THE SUPER CUB AND PA-18-A

The new 1952 125 hp Super Cub with high-lift flaps takes off and lands in less than 50 yards, holds the world altitude record of 30,203 feet. It's a plane of hundreds of uses for farm, ranch, patrol, freight carrying, exploration, landing in remote areas.

New agricultural version, model PA-18-A, has 110 gal. (18 cu. ft.) capacity as duster, sprayer or combination unit. Outperforms aircraft of twice the power, lays 50-foot swath, lands closer to jobs for quicker loading. Wire cutters, shoulder straps, many other special features. Write for special PA-18-A brochure.